March 2008

Operations Manual for Air Quality Monitoring in Ontario

Ministry of the Environment
Operations Division
Technical Support Section

PIBS 6687e

Protecting our environment. Ontario

Table of Contents

List of Tables

Disclaimer: This manual is not, and should not be construed as, legal advice. Please review applicable laws, including Ontario Regulation 419/05, and, if you have any questions about the application or interpretation of the legal requirements or have other legal questions, you should consult a lawyer.

Operations Manual for Air Quality Monitoring in Ontario

Overview

This *Operations Manual for Air Quality Monitoring in Ontario* is an update of the 2003 version (*Operations Manual for Point Source Air Quality Monitoring*) developed by the Ontario Ministry of the Environment (ministry). The manual was originally developed as the ministry transferred the responsibility for monitoring the impact of industrial air emissions on local air quality from the ministry to emitters. This manual is to be used when the need for air quality monitoring by an emitter has been identified. The ministry continues to provide oversight of air quality monitoring conducted by emitters by adopting the role of auditor.

This newly revised Operations Manual, hereafter referred to as the Manual, captures the lessons learned during the first years of the program. The Manual has also been updated to recognize monitoring that may be conducted under Ontario Regulation 419/05: Air Pollution – Local Air Quality with respect to current, new or updated air standards and guidelines. The Manual also introduces standard operating procedures (SOPs) for new air monitoring and sampling technologies used by emitters.

The purpose of the Manual is to provide technical guidance and direction to emitters and station operators in Ontario who are responsible for the operation and maintenance of air quality monitoring stations near an emitter's facilities. It provides a framework with the goal of harmonizing air contaminant monitoring across the province. The intent of the Manual is to ensure the collection of reliable and accurate air quality data, and to ensure that the data is collected and reported to the ministry in a timely fashion, as appropriate.

The requirements set out in the Manual are considered to be minimum requirements to satisfy the ministry that the quality of data being collected from monitoring programs is acceptable. Emitters and station operators may choose to follow more stringent specifications or more elaborate procedures. Additionally, the ministry may also require more stringent criteria. The Manual is based on standards and procedures used by national agencies such as the U.S. Environmental Protection Agency (US EPA) and Environment Canada.

The 2003 manual will remain in affect until December 31, 2008. This revised manual will take affect January 1, 2009. However, emitters are encouraged to follow the revised manual prior to January 2009, where possible. New monitoring activities will be required to follow the revised manual immediately. The Manual is considered to be a living document which will be reviewed and revised periodically to reflect the introduction of new monitoring and data collection technologies and practices, as well as changing ministry requirements for air quality monitoring in Ontario.

Scope of the Revised Manual

The Manual is a compilation of guidance material pertaining to the collection and reporting of air quality data for both continuously monitored and non-continuously sampled parameters. The Manual applies to all air quality monitoring activities conducted in Ontario by emitters that:

- are requirements of legal instruments, e.g., control orders, certificates of approval, memoranda of understanding
- are part of modelling/monitoring assessments conducted under section 11(3) of O. Reg. 419/05
- results in monitoring data being submitted to the ministry
- generates air quality data which will be presented to health units and/or to the public of Ontario

The Manual includes the following topics:

- Quality Assurance/Quality Control (QA/QC) Guidance
- Requirements for reporting monitoring and sampling results to the ministry
- Station and Probe Siting Criteria
- Standard Operating Procedures (SOPs) for continuous monitoring and non-continuous sampling methods

Section 1, QA/QC Guidelines, discusses monitoring and QA/QC objectives, the QA/QC program, site selection, sampling system requirements, site and analyzer operation, calibration and reference standards, the ministry's audit program, and laboratory selection and analytical testing.

Section 2, Data Validation and Reporting, discusses data editing and validation protocols along with reporting guidance for continuously monitored and non-continuously sampled parameters.

Section 3, Station and Probe Siting Criteria, provides guidance on the selection of sites to meet the objectives of the monitoring program. It also provides guidance and requirements for the proper location, and design and construction of inlet probes for the parameters listed in the Manual.

Section 4, the SOPs, briefly describe, on a parameter by parameter basis, the USEPA designated reference methods, equivalent methods and available reference documents from various agencies, non-designated monitoring methods accepted by the ministry, the minimum service, operation and maintenance requirements, instrumentation QA/QC requirements (internal and external performance checks), and audits by the ministry. The SOPs are not intended to provide a detailed description of monitoring/sampling methods: Emitters and site operators need to review the method reference documents for detailed method descriptions.

Key Revisions

There are a number of revisions in this edition of the Manual. The key revisions include:

Data Acquisition System (DAS):
All references to the Environmental Monitoring Company (EMC) DAS system have been removed to emphasize that any DAS capable of meeting ministry requirements for the collection, transmission, reporting and storage of continuous data is acceptable.

Certification/Verification of Calibration Equipment by the Ministry:
The ministry's Laboratory Services Branch (LaSB) can certify annually the gas calibration devices used by site operators, with traceability to United States National Institute of Standards and Technology (NIST) primary standards. The ministry will also verify/check these devices in the field between certifications. In addition, flow, temperature and barometric pressure calibration equipment must have their certification traceable back to NIST (or another equivalent international standards institute) primary standards according to the frequency recommended by the equipment manufacturer. Since the ministry is not providing this service, site operators should obtain the necessary certification equipment or the certification services from a third party capable of providing the equipment or service.

Ministry Audit Program:
The Manual provides a broader description of the ministry's audit program. The Manual briefly describes what emitters or site operators can expect during an audit, and the focus and scope of audits.

Laboratory Accreditation and Selection:
Although the ministry recommends the use of accredited or certified laboratories, it will allow the use of a laboratory which does not have the required accreditation provided the ministry can review and approve the selection of the laboratory, the proposed analytical methodologies and QA/QC procedures. The ministry will maintain an updated list of Ontario analytical laboratories accredited by the Standards Council of Canada or the Canadian Association for Environmental Analytical Laboratories and will post this list on the ministry web site.

Data Validation and Reporting:
Additional guidance is provided for data validation and reporting requirements. Time stamping requirements for continuous and non-continuous data have been clarified. Guidance is provided on how to deal with the analysis of non-continuous data when values are less than the analytical method detection limits (MDLs). The requirements for collecting and reporting real-time data are explained with respect to time resolution, averaging periods and reporting format. These requirements also take into consideration the exceedence reporting requirements set out in O. Reg. 419/05.

PM_{10} is now listed in Ontario's Ambient Air Quality Criteria (AAQC) which can be found at: http://www.ene.gov.on.ca/en/air/ministry/index.php#reg. There is still a need to report PM_{10} data and exceedences of its interim AAQC.

Meteorological Data:
Meteorological data collected as part of a monitoring program will be reported to the ministry and meteorological stations will be audited.

Standard Operating Procedures (SOPs):
The list of continuous monitors has been expanded. Additions include inhalable (PM_{10}) and respirable ($PM_{2.5}$) particulate matter using the Tapered Element Oscillating Microbalance (TEOM), Beta Attenuation Monitor (BAM), MetOne Aerocet 7350, and GRIMM (model 107).

Additions to the list of non-continuous samplers include particulate matter using the R & P Partisol FRM 2000 sampler ($PM_{2.5}$) and BGI PQ100 and PQ200 ($PM_{10/2.5}$); polycyclic aromatic hydrocarbons (PAHs) using a hi-vol filter with PUF cartridge; and volatile organic compounds (VOCs) using evacuated canisters.

Emitters and station operators who routinely follow the procedures described in the Manual as closely as possible and adopt good preventative maintenance practices should be able to produce accurate and timely air quality monitoring data which surpasses the minimum requirements listed in the Manual.

1. QA/QC Guidelines for Source Emissions Monitoring

1.1 Introduction

This section provides quality assurance and control (QA/QC) guidance and direction to emitters in Ontario that are responsible for monitoring air quality near their facilities. To ensure the data reported to the ministry is of high quality, emitters are required to implement the QA/QC practices in this Manual: these practices are minimum requirements. Participants may choose more stringent specifications or more elaborate QA/QC procedures as they deem appropriate for their purposes.

1.2 Monitoring Objectives

The objectives of air quality monitoring include:

- Measuring air contaminant concentrations for use in assessing emissions in relation to ministry standards and limits (O. Reg. 419/05 standards, point of impingement (POI) guidelines, ambient air quality criteria (AAQCs), interim guidelines, or any other limits set out in a regulatory instrument such as an Order or Certificate of Approval). A summary of O. Reg. 419/05 schedule 1, 2 and 3 standards, schedule 6 upper risk thresholds, POI guidelines and AAQCs is available from the ministry website:

  http://www.ene.gov.on.ca/

- Measuring air contaminant concentrations of any contaminant that may cause an adverse effect.
- Ensuring good quality data is collected to assist in the prevention of possible adverse effects due to air emissions from an industrial facility.
- Providing and reporting accurate measured air monitoring data from industrial sources to the ministry and the Ontario public.
- Providing accurate and reliable measured air pollutant concentration and meteorological data in support of air quality modelling calculations (see ministry document "Procedure for Preparing an Emission Summary and Dispersion Modelling (ESDM) Report" for information on incorporating monitoring data into modelling).
- Determining the impact of industrial air emissions on local air quality in an adjacent community(ies) and in the regional air shed.
- Providing accurate and reliable data as part of an integrated air quality management and/or control system.
- Determining air quality improvements and trends in conjunction with industrial air emissions abatement programs.
- Providing data to assess local population and ecosystem exposure to air contaminants.

The results of ambient air monitoring can be used to identify non-compliance/non-conformance with the standards in O. Reg. 419/05 and other limits. However, it should be noted that the ministry will not accept monitoring information alone as a conclusive

demonstration of compliance/conformance with the standards in O. Reg. 419/05 or other limits. One rationale for this position is that a monitor can only measure concentrations at a very specific location and cannot provide information about concentrations at other locations.

To address such limitations of solely using ambient air monitoring or atmospheric dispersion modelling, the most accurate assessments of compliance with O. Reg. 419/05 must include the combination of ambient air monitoring with atmospheric dispersion modelling. Appendix E (Review of Approaches for the Combined Analysis of Modelled and Monitored Results) of the ministry's Procedure for Preparing an Emission Summary and Dispersion Modelling (ESDM) Report, provides guidance on the coordinated use of modelling and monitoring to assess compliance with O. Reg. 419/05. Any ambient air monitoring plan for combined monitoring and modelling assessment submitted by emitters as part of O.Reg.419/05 must be a reviewed and approved plan under Section 11(1) paragraph 3 of O.Reg.419/05. Plans are subject to certain requirements, for example, meeting siting criteria, potentially subject to ministry audits, etc.

1.3 Quality Assurance and Quality Control (QA/QC) Objectives

The QA/QC guidelines within this manual provide uniform data quality objectives to be achieved by emitters along with minimum requirements with respect to operational protocols. The implementation of these guidelines will ensure that air quality monitoring data across the province is:

- accurate and reliable
- representative (spatially and temporally)
- comparable
- complete

1.4 QA/QC Program

The Environment Canada report entitled *National Air Pollution Surveillance Network Quality Assurance and Quality Control Guidelines*[1] documents the components of an air quality monitoring QA/QC program, which includes the following:

- site selection (spatial scale of representativeness, location, separation distances)
- sampling system requirements (shelter requirements, probe/analyzer siting criteria, manifold design, probe material)
- site and analyzer operation (site visits, operating procedures, data acquisition and preventative maintenance)
- calibration (frequency, procedures, guidelines)
- instrumentation performance audits, laboratory accreditation/selection and testing
- data validation and reporting
- documentation (site documentation, site activities logbook, analyzer operation and maintenance manuals, QA/QC manual)
- personnel training

1.5 Monitoring Plan

Prior to initiating ambient air quality monitoring activities, the emitter must submit a monitoring plan to the ministry for approval. For example, plans must be submitted for (i) monitoring activities undertaken either voluntarily or as required in legal instruments such as Notices, Orders or Certificates of Approval and (ii) combined monitoring and modelling assessments submitted to the ministry as part of O.Reg.419/05, as per section 11 (1) 3. It is recommended that the emitter consult with their regional ministry office early in the planning stages. The purpose of the ministry review of the monitoring plan is to ensure the data collected and submitted to the ministry is accurate and reliable in terms of assessing compliance and/or the potential for adverse effects. Monitoring plans will be reviewed and approved in writing by the ministry following a consultative process with the emitter.

The monitoring plan, as a minimum, must include the following:

- purpose or objectives of the monitoring program
- expected duration of the monitoring program
- identified and suspected air emission source(s)
- identified and suspected receptors
- number and location of monitoring sites (including meteorological sites)
- air quality parameters to be monitored and the monitoring frequency
- monitoring methods/instruments to be used
- analytical methods/procedures
- laboratory services support to be used
- dispersion model to be used (if applicable)
- QA/QC plan
- data reporting procedures

Once the network has been established any changes to the monitoring plan such as new instruments, new monitoring locations, etc., must be submitted in writing for approval to the Air, Pesticides and Environmental Planning Supervisor at the ministry regional office in the region of the emitter's facility.

1.6 Site Selection

Site selection must consider the location of identified or suspected sensitive receptors and the locations where the highest concentrations of air contaminants are anticipated based on meteorological and modelling information. The proponent should consult with the ministry early in the site selection process. All monitoring sites must be located in accordance with ministry siting criteria (see Section 3.0) and the locations must be approved in writing by the ministry as part of the monitoring plan. Taking practical circumstances and limitations into consideration, the criteria need to be met as closely as possible. The location of sites may be reviewed or audited from time to time by ministry staff to ensure that the monitoring objectives and siting criteria are, and will continue to be met in the foreseeable future. Monitoring sites may only be relocated with approval from the ministry.

1.7 Sampling System Requirements

The integrity and true representation of the air sample and the resulting data quality is strongly affected by the design of the sampling system in a monitoring station. The following all play an important role in ensuring the collection of representative samples of air: temperature stability of the shelter, the location of the sampling probe(s), the manifold or sample inlet line system, the length of the probe, probe construction material and the filters/fittings.

1.7.1 Shelter Requirements

Continuous analyzers must be housed inside secured buildings or shelters with restricted and/or controlled public access. It is recommended that the analyzers be housed in their own dedicated shelter for better control over concerns such as security, temperature stability, dust levels, health and safety, and after hours or weekend access. The shelter must be ventilated, heated and cooled to maintain an inside temperature in the range of 15°C and 30°C throughout the year to meet the specifications of the housed instrumentation. It should have good lighting, and must have an adequate electrical power supply. The shelter must also provide adequate space and electrical power supply to allow ministry personnel to operate audit equipment. Communications service should be available for data transmission telemetry. It is recommended that an appropriate fire extinguisher and a first aid kit be furnished for emergency situations. Consideration should be given to the use of an intrusion alarm and/or a chain link fence around the shelter and adequate exterior lighting to secure the facility and protect it against vandalism. The shelter location requirements, with respect to surrounding obstructions, are summarized in the Station and Probe Siting Criteria section (Section 3.0).

1.7.2 Probe Siting Criteria and Manifold Design

Air sample inlet probe construction materials along with the design of the inlet manifold are important in obtaining representative air samples and conserving the integrity of the contaminant concentrations. The design of the inlet manifold should minimize the effects of moisture condensation, pressure drop, dust settlement and air sample residence time in the inlet. To achieve this goal, the inlet manifold design must adhere to the requirements outlined in Appendix II of the Environment Canada QA/QC guidance document[1]. Regular inspections of the inlet line and manifold are required to ensure that they are kept clean and have no air leaks.

1.8 Site and Analyzer Operation

The operation of the monitoring stations, analyzers and samplers must include site visits by the operating party, regularly scheduled zero and span verification, manual calibrations, sample filter changes (e.g., discrete particulate samplers), preventative maintenance and documentation.

1.8.1 Site Visits and Analyzer Operations

The frequency of site visits will depend on system and instrument reliability, recommended manufacturer service and maintenance requirements, and past experience with site operations. A schedule of routine bi-weekly visits is recommended. More frequent visits are suggested, for example, to check instrument calibration as soon as possible after a pollution episode, or if there is any doubt about station and analyzer operations. This will require judgment on the part of the operator. Each operation and maintenance site visit by the operator must be documented in the site logbook or an electronic logbook. A sample pollutant log for SO_2 is shown in Appendix 1). The operator should also follow a checklist of activities to ensure proper operating conditions before leaving the site. The Environment Canada QA/QC guidance document[1] provides a checklist for consideration by site operators (see Appendix 2).

The ministry SOPs for continuous analyzers (SO_2, TRS and NO_x) require, as a minimum, a monthly external performance check and calibration using a certified calibration unit. Quarterly external performance checks are required for the TEOM and the BAM as well as for the non-continuous particulate samplers.

The operator must be trained and have experience in the operation of each continuous analyzer and non-continuous sampler used, and closely follow the procedures in the manufacturer's operating manual and the ministry SOPs listed in Section 4.0.

1.8.2 Data Acquisition

For continuous monitoring of air contaminants and meteorological parameters, a real-time data acquisition system (DAS) to collect, display and report the data is required. DASs have a wide range of capabilities (e.g., telephone, wireless, radio link, satellite communications, editing and reporting software, etc.) and emitters/site operators should select systems that suit their needs and also meet the requirements specified by the ministry.

1.8.3 Preventative Maintenance

Preventative maintenance routines specified in the manufacturer's operation and maintenance manuals of the analyzer or sampler should be followed as closely as possible. Operators may wish to follow more stringent procedures.

1.9 Calibration and Reference Standards

In combination with automatic zero and span checks, calibrations are used to establish the validity of the data. Calibration procedures set out in analyzer and sampler operation manuals should be followed; they are considered to be part of this QA/QC guide. Ministry SOPs (Section 4.0) describe automatic zero and span checks, internal and external instrumentation performance checks, and calibration check requirements with respect to frequency, duration, documentation and any required corrective actions. These are operational requirements that must be followed. Site operators should also refer to Appendix III and IV of the Environment Canada QA/QC guidance document[1] for additional information on calibration procedures.

There are many models and makes of dilution calibrators designed for dynamic calibration of ambient air analyzers. Gas cylinders, permeation devices or a combination of both can be used as calibration source materials. The operator must be properly trained and have experience in the operation and maintenance of the calibrator. Federal and Provincial Health and Safety legislation must be followed with respect to operator training and the proper handling and shipping of calibration materials.

Ministry SOPs state that operators must perform an external performance check and calibration on continuous and non-continuous air monitoring and sampling equipment with a certified calibration unit. This requires that the calibration materials/gases and measurement devices, such as flow meters and pressure gauges, must be certified for accuracy against a reference or transfer standard traceable to a primary reference standard of the United States National Institute of Standards and Technology (NIST) or another equivalent international standards institute. This is to ensure consistency across the province and reproducibility. The responsibility for ensuring that calibration materials and measurement devices have the required certification rests with the emitter.

At least once per year, formal certification of Environnement S.A VE3Ms (ESAs) or other gas calibration devices by the ministry's Laboratory Services Branch (LaSB) or an alternate calibration device certification authority is required. Please note that there may be a cost recovery fee associated with this service if provided by the ministry. The ministry will also verify/check, at least once per year in the field, the ESAs or other gas calibration devices used by site operators and/or confirm that the annual certification has been performed. This verification is not intended to substitute for the formal certification but is to ensure on-going acceptable performance of the calibration equipment used by site operators between annual certifications.

Flow, temperature and barometric pressure calibration equipment must have the certification traceable back to NIST (or another equivalent international standards institute) standards according to the frequency recommended by the manufacturer. This can be accomplished by obtaining the necessary equipment or certification services from a third party capable of providing the equipment or service.

1.10 Audit Program

Ministry staff will regularly audit industrial monitoring activities and procedures. Authority for these audits can be found under Section 156 of the Environmental Protection Act (EPA). The audit program will determine the effectiveness of quality control activities used by station operators and data management staff. Ministry staff aim to ensure province-wide consistency by conducting audits.

1.10.1 What to Expect when Audited

Ministry auditors will notify the emitter's management representative or the air quality station operator approximately one week in advance of conducting an announced audit. Prior to the first audit ever, ministry staff will arrange a meeting with emitter management

and the station operator to provide the scope of the audit, the obligations of the auditor and auditee, and a list of the documents the auditor will need to review while on-site.

A station operator or an emitter's management representative must accompany ministry audit staff to access the sites and witness the audit. During the on-site audit, the auditors will introduce themselves on arrival; and if required provide information on the reason(s) for the audit, the statutory authority (the law) governing the audit (EPA Section 156) and the scope of the audit. Ministry audit staff are also able to address concerns brought forward and should provide clear, detailed explanations of ministry requirements when necessary. They will address issues in a courteous, respectful manner and will treat emitter's management representatives and site operators with fairness and consistency. They will also provide a contact number should further information or feedback be required. Site operators and emitters' management representatives are encouraged to ask any questions they may have about the audit process or ministry guidelines and requirements.

While on-site, and after the audit is completed, the preliminary results will be reviewed with the site operator or emitter's management representative who will be asked to sign the audit results worksheet(s) as having witnessed the audit. If the ministry audit criteria are met, based on instrumentation performance checks such as air sampling flow rates and responses to test gas concentrations, etc., the audit results will be provided in writing by the auditor to the emitter's management representative and the site operator via a formal audit report. If the audit criteria are not met, the auditor will provide the site operator with the option of immediately resetting the instrument within acceptable tolerances. At that time, the auditor will advise the site operator or the emitter's management representative of corrective actions that may be required. A report of the results and of any corrective actions required will be sent to the emitter as part of the audit report. Depending on the circumstances and follow-up actions, the ministry may re-audit an instrument that did not meet the audit criteria.

After the audit, the auditor may contact the site operator or emitter's management representative prior to finalizing audit reports to clarify information or to discuss details of the results.

Periodically, short-notice audits may be conducted. In this case, the site operator or emitter's management representative will be given minimal but reasonable notice.

1.10.2 Audit Focus and Scope

The main focus of the audit program is to ensure that air quality measurements recorded by emitters are collected, managed and reported to the ministry in a manner that ensures the integrity of the collected and reported data. Air quality monitoring comprises a number of activities, processes, procedures and data management practices. These include the locating of air monitoring stations following established siting criteria; the proper installation, operation and maintenance of analyzers and samplers; sample analysis in a laboratory; data management and reporting; and information management.

In situations where an emitter has hired a third party to operate and maintain air quality monitoring stations, and to report monitoring data to the ministry, the ministry considers the emitter to be responsible for the station. Audit reports will be sent to the emitter. Third

party operators will be sent a copy.

The scope of the ministry audit program is to determine the overall performance of monitoring activities performed by the emitters and conformance to generally accepted QA/QC requirements for air quality monitoring and data reporting. This is best accomplished through a *'Systems Audit'*, that is, a comprehensive audit that incorporates all activities, processes, procedures and practices related to the collection and reporting of air quality data by emitters. The *'Systems Audit'* has essentially three components: a *'Site Audit', 'Instrument Performance Audit'* and an *'Information Management Audit'*.

Site/Instrument Performance Audit

Site audits include, but are not restricted to:

- how well sites conform to siting criteria
- site maintenance

Instrument performance audits include, but are not restricted to:

- proper installation of instruments and sampling devices
- overall condition of instruments and sampling devices and performance of required maintenance
- assessment of the complete sampling system
- instrument performance checks
- sample handling, storage and shipping
- collocated monitoring by the ministry (if deemed necessary)

A site audit will periodically be performed in conjunction with an instrument performance audit. The instrument performance audits are conducted with certified audit devices (e.g., portable gas calibrators, flow meters, temperature and barometric pressure sensors, gas cylinders) traceable to a NIST (or another equivalent international standards institute) standard.

As described in the SOPs (section 4.0), instrument performance audits will be performed by ministry staff at least quarterly for continuous analyzers, at least semi-annually for non-continuous samplers and every one to two years for meteorological sensors. The frequency of audits will also depend on performance. Additional audits by the ministry or a calibration check of the analyzer(s) by the site operator after a measured pollution incident may also be required.

For the purposes of the audit, and hence data quality acceptability, the ministry will use a conformance/non-conformance limit of ±10% of the test gas value or of the sampler air flow rate. Non-conformance with this criterion will require that the emitter, in consultation with the ministry, take corrective actions and advise the ministry in writing of any actions taken. Corrective actions may include data editing to correct historical data. In cases where criteria are not met, a follow-up audit by ministry staff may be required to ensure that appropriate corrective actions have been taken in a timely manner. For continuously monitored parameters (such as SO_2 or TRS) acquired with a telemetry system, an audit starting from the analyzer through to the emitter's central computer will be undertaken periodically to ensure

that the data recorded by the analyzer is correctly transmitted to and stored in the operator's data acquisition system. Finally, the ministry's LaSB may also participate in these audit activities with respect to the selection, use and performance of private laboratories.

Information Management Audit

Information management audits apply to all aspects of information collection, handling, storage and retrieval, this includes but is not limited to: record keeping (instrument operation and maintenance logs, sample submission chain of custody forms, data validation/editing, site activity logs, etc.); continuous data computer storage and back-up procedures; DAS time verification procedures; data editing/reporting protocols (reporting of method detection limits, required statistical analyses) and required formats; laboratory reports, etc. The ministry will incorporate information management audits. These will be done annually.

1.11 Laboratory Accreditation/Selection

For environmental samples which require laboratory analyses, such as particulate matter and its constituents (e.g., trace metals, PAHs, PCDD/DF, etc.) and VOCs, the ministry strongly recommends that all environmental laboratory services work be performed by laboratories whose analytical methods, as required by the monitoring program, are accredited to the international standard[2]. The ministry will allow the use of a laboratory which does not have the required accreditation provided the ministry can review and approve the selection of the laboratory, the proposed analytical methodologies and the QA/QC procedures. The ministry will provide advice and guidance in assisting the emitter in selecting an environmental analytical laboratory for required analytical services.

Accordingly, the ministry's LaSB has prepared a document entitled *Selecting an Environmental Analytical Laboratory* [3] which provides guidance on the process of selecting an accredited contract laboratory and covers topics such as drafting a request for proposal (RFP), assessing laboratory performance, data quality, and setting up a contract. To obtain a copy of the document, please submit your written request to: Laboratory Services Branch, 125 Resources Road, Etobicoke Ontario M9P 3V6, care of the Assistant Director.

The ministry will maintain an updated list of Ontario analytical laboratories accredited by the Standards Council of Canada (SCC) or the Canadian Association for Environmental Analytical Laboratories (CAEAL) to perform specific air analyses and will post this list on the ministry's web site at http://www.ene.gov.on.ca. This list has been derived from accreditation scopes posted on both the SCC and CAEAL web sites and is scheduled to be updated quarterly; however, this may not ensure its accuracy or completeness. Errors or omissions should be reported in writing to the ministry's Laboratory Services Branch, 125 Resources Road, Etobicoke, Ontario, M6P 3V6 care of the Assistant Director. Accredited laboratories operating outside of Ontario may request to be included on the list by writing to the same address.

The analytical methods accepted by the ministry's LaSB are referenced in the relevant SOPs presented in Section 4.0. Copies of these method descriptions are available from the ministry's LaSB, Customer Services at (416) 235-6311. Alternatively, requests can be e-mailed (LaboratoryServicesBranch@Ontario.ca) and a PDF copy of the method will be

provided within one business day: please provide your full contact details including address and telephone number.

Questions regarding these methods or the list of accredited or certified laboratories can also be directed in writing to the address above.

It is important to note that the ministry requires analytical method detection limits (MDL) for laboratory analyzed samples to be at least a factor of ten lower than the applicable O. Reg. 419/05schedule 1, 2 and 3 standards, POI guidelines and AAQCs. Information on MDLs and how they are to be used in reporting data is provided in section 2.2. MDLs do not apply to continuous monitoring instrumentation.

2. Data Validation and Reporting

2.1 Data Time Stamps

All continuous and non-continuous data in the province are to be collected and reported in standard time throughout the year. In most of the province Eastern Standard Time (EST) is to be used, however, in north-western Ontario (parts west of longitude 90° west), Central Standard Time (CST) is to be used. For continuous data, this applies not only to the 'raw' real-time data but also to the means calculated from this data. The ministry recommends that computer clocks used with real-time data acquisition systems be checked at least monthly against a reliable time standard such as the computer system's server clock. The 24:00 hour system is to be used: the first hour of the day is to be shown as 0:00 hr, such that a 24-hour monitoring period is from 0:00 to 23:00 hrs. An hour is defined as the 'hour beginning', for example, the hourly mean for 14:00 hours is computed from readings collected from 14:00 to 14:59 hours.

2.2 Method Detection Limits

The ministry SOP entitled *LaSBSOP.026, Revision 3.0 August 15, 2006*[4] describes the determination of the limit of measurement (w), the limit of reliability (T) and the method detection limit (MDL). These limits apply to all quantitative analytical measurements employed by LaSB.

The MDL will be the limit used to qualify data in order to ensure that a simplified and standardized approach is used across the province in dealing with measurements that are reported as being below the limit of the sampling and analytical methods employed. A copy of the SOP is available from the ministry's LaSB, Customer Services at (416) 235-6311.

The SOP defines the MDL as the smallest measurable amount, where the risk of a false positive is 1%, or conversely the confidence level is 99%. For a more thorough discussion of MDL, please see the ministry publication entitled *Estimation of Analytical Detection Limits*[5] available from the ministry's LaSB, Customer Services at (416) 235-6311. The laboratory whose analytical services will be used for any air quality monitoring program should review these documents, and contact the ministry's LaSB, Customer Services at (416) 235-6311 with any questions regarding the MDLs to be reported.

As previously stated, the ministry requires an MDL which is at least a factor of ten (one order of magnitude) lower than the applicable O. Reg. 419/05 schedule 1, 2 and 3 standards, POI guidelines and AAQCs. Site operators or emitter's environmental representatives should contact their ministry regional office at the program planning stage if it is suspected that the analytical method(s) contemplated for the proposed air monitoring program may not be able to meet this requirement.

The analytical lab needs to provide the MDL for each substance analyzed in the final engineering units reported to the ministry (e.g., $\mu g/m^3$). In addition, the lab will report a result with a value lower than the MDL as '< 0.00x' for an MDL of 0.00x.

For the purpose of performing statistical analyses (e.g., means, etc.) and in keeping with a commonly accepted practice, a value of half the MDL must be substituted for concentrations less than the MDL. These values will be counted as non-detects. The percentage of the data with values above the MDL should also be reported.

The goal of this approach is to provide a level of consistency for emitters reporting non-continuous data to the ministry. For data generated by continuous monitors, the analyzers have MDLs typically much lower than the applicable limits. In this instance, data acquisition systems report values less than MDLs as zeros. It is common practice to report these as zeroes in the database and to treat these as zeroes in calculating short and longer term means.

In the event that stated MDLs are comparable to or greater than applicable standards, especially for substances whose standards are based on human health impacts or substances with upper risk thresholds (see schedule 6 of O. Reg. 419/05), a more refined statistical approach may be required to deal with MDLs if the data are to be used to estimate risks. This would occur when there is a need for risk assessors to impute a series of values that represent concentrations below the stated MDL, and when the non-detects comprise a significant portion of the data set. This is to be handled on a case-by-case basis in consultation with ministry experts.

2.3 Meteorological Data

The submission of meteorological data to the ministry as part of air quality monitoring activities does not constitute approval of the data for regulatory purposes. If there is any intention to use meteorological data for modelling under O. Reg. 419/05, the meteorological instrumentation must meet the requirements of O. Reg. 419/05 and be included in the audit program. Approval for the use of site specific meteorological data for modelling must be obtained from the ministry as per the requirements of O. Reg. 419/05. The approval form is available at: http://www.ene.gov.on.ca/envision/gp/5350e.pdf. Notwithstanding the regulatory use of meteorological data, all meteorological instrumentation generating data as part of air quality monitoring will be subject to audit.

The standard equations for calculating wind speed and direction values are shown in Appendix 5.

2.4 Data Validation/Editing

A data validation process to filter out erroneous data is critical to maximize data integrity. Validation can be done using automated or manual procedures. Regardless of the process followed, judgment to accept or reject suspicious or unusual data is required. Many factors need to be considered in this process, which requires regular inspection of all data by experienced staff that have an understanding of local pollutant and climatic conditions as well as knowledge of air pollution principles and analyzer behavior.

Emitters will be responsible for ensuring that the data editor follows the recommended data editing and validation protocols outlined in Section 4.1 for continuous data and in Section 4.2 for non-continuous data. These are minimum requirements. Staff responsible for data

editing and validation can also refer to, and use, protocols established by other agencies (e.g., Environment Canada, USEPA), as long as the requirements outlined in Sections 4.1 and 4.2 are met.

2.4.1 Continuous Data

As per the guidance in Section 2.5, raw and edited continuous data must be submitted electronically to the ministry on a quarterly basis. The data is to be submitted in a resolution of half-hour means. The ministry's regional office may request alternate data resolutions. The resolution required to be submitted is subject to change if the averaging period for the limits change. The emitter is advised to contact their regional ministry office to confirm the data resolution required as well as associated reporting requirements.

Automated data acquisition systems (DASs) used by emitters or site operators must meet the requirements for acceptable data editing and validation.

The following general rules apply to editing continuous data:

- Editing of continuous data, as stated above, will be done on half-hour resolution data. The ministry may periodically request the editing and submission of data collected at a resolution of 5 minutes, for example in the case of an exceedence or a spill. Data collected with resolution times shorter than 5 minutes (e.g., 1 minute means) are to be left as is, as a permanent record.
- For ministry submissions, a minimum of 75% of the readings within an averaging period must be valid for the means to be considered valid. For example, a valid 1-minute mean requires at least 45 1-second readings, a valid 5 minute mean requires at least 4 1-minute means and a valid 1 hour mean requires at least 45 1-minute means. This qualification must be applied for the determination of % valid data collected.
- For the purpose of calculating a valid annual mean, at least 75% of the half-hour or hourly means must be valid, that is, 6570 valid hours out of a total of 8760 hours, are required. A valid monthly mean requires at least 23 valid daily means. A valid 24-hr mean requires at least 18 valid hours out of 24 hours. Additionally, for a good representation of quarterly or seasonal means at least 75% of the data in each quarter or season must be valid.
- The tolerance limits for editing of hourly data are ±10% of the calibration standard.
- Data should be edited within 30 days of the end of the month in which it was collected.
- Zero drifts, beyond 5 ppb for SO_2 and NO_x and 2 ppb for TRS, require an off-set adjustment.

All edits of continuous data must be reported to the ministry in an edit log table such as the example shown in Appendix 4 (Table 11).

Data Storage/Backup

The ministry requires that all continuous data for the current and previous calendar year be stored in the data acquisition central computer. Older data should be archived in an acceptable format, in a reliable electronic medium, and must be stored by the emitter for a period of at least 7 years after its collection. It is recommended that the continuous data be backed up at least weekly.

2.4.2 Non-continuous Data

The SOPs outlined in section 4.2 are based on those currently used by the ministry and are considered to be minimum requirements. Additional guidance is also provided in field method documents referenced in the SOPs and in the ministry's Laboratory Methods/Procedures documents. The use of other sample and data validation procedures is acceptable as long as the requirements for acceptable data editing and validation are met.

For air quality monitoring purposes, non-continuous data is usually obtained from the collection of monthly (30 days) samples (e.g., dustfall, fluoridation candles) and daily (24-hour) samples (e.g., TSP, PM_{10}, VOCs, PAHs, etc.). The daily samples are normally collected from midnight to midnight (EST and CST depending on the applicable geographical time zone), and the sampling schedule for TSP and PM_{10} follows the standard North American every 6^{th} day schedule. A different schedule (every 3^{rd} day) is sometimes used or required to collect more samples in a given year. The sampling frequency for PAHs, VOCs, and dioxins/furans typically occurs every 12^{th} day on the North American schedule. These sampling schedules, or other schedules possibly required for special studies or assessments, need to be reviewed by the ministry for concurrence.

The following general rules apply to editing non-continuous data:

- A monthly sample is considered to be valid if the exposure period is within +/- 5 days of the 30 day period (calendar month); it is also desirable to have the 'on' and 'off' dates as close as possible to the start and end of a calendar month in order to minimize uncertainty in the determination of the exposure month.
- The tolerance limit for editing daily parameters is ±10% of the air flow calibration standard.
- A daily sample is considered to be valid if the sampling period is within ±10% of the required 24 hours, that is, from 21.6 to 26.4 hours. Additionally, for TSP and PM_{10} hi-vol samples, the air volume sampled over this time period must be within ±10% of the required theoretical total air volume of 1631 m^3, that is, from 1468 m^3 to 1794 m^3. For $PM_{2.5}$ samples collected with a discrete sampler operating with a flow rate of 16.7 liters per minute, the air volume sampled over a 24 hour period must also be within ±10% of the required theoretical total air volume of 24 m^3, that is, from 21.6 to 26.4 m^3.
- A valid annual arithmetic or geometric mean requires at least 75% of the total number of possible samples under the relevant sampling frequency to be valid. Hence, for monthly sampling, at least nine (9) months of valid data are required,

whereas for daily sampling the following number of valid 24-hour sample results are required:

Sampling schedule	Number of valid samples required
Every 3rd day	90
Every 6th day	45
Every 12th day	23

- For calculating quarterly or seasonal means, at least 75% of valid data for each quarter or season of the year must be available.

All edits of non-continuous data must be reported to the ministry in an edit log table such as the example shown in Appendix 4.

2.5 Data Reporting

This section discusses the various reporting requirements. The requirements apply to all long-term (multi-year) monitoring and sampling. Reporting requirements and accessibility of real-time data may vary for shorter term monitoring and sampling depending on the purpose: This would be identified during the development of the monitoring plan. Continuous data is to be made available to the ministry in real-time. Additionally, data (continuous and non-continuous) along with associated reports, are to be submitted to the ministry on a quarterly and/or annual basis as described below. Submitted monitoring data will be uploaded into a ministry database.

For continuous and non-continuous data, the emitters shall notify the ministry, as soon as practicable, of measured exceedences of the limits specified in O. Reg. 419/05, and forthwith (or as required) of measured exceedences of limits in ministry Certificates of Approval, Orders or of other statutory or regulatory limits. Section 28 of O. Reg. 419/05 contains requirements to notify a provincial officer in writing as a result of modelled or measured exceedences of the standards in the Regulation or of discharges that may cause an adverse effect.

Some contaminants are not listed in Schedules 1, 2 and 3 of the Regulation, but are instead listed as a half-hour point of impingement (POI) guidelines in the document entitled *Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution*. As well, contaminants may be listed in the document entitled *Ontario's Ambient Air Quality Criteria*. Exceedence of a POI guideline or of an AAQC may cause adverse effects and as such would trigger the requirement to notify a provincial officer. As such, standard, guideline and AAQC limits have been included in the Notification of Exceedence Form (5354e) which can be found on the ministry internet site:

http://www.ene.gov.on.ca/en/air/ministry/index.php

It is an offence to have a monitored or modelled exceedence over any applicable averaging period. For example, for a contaminant with a half-hour averaging period, it would be an offence to have an exceedence over any half-hour period during the day. Similarly, for a

contaminant with a 24-hr averaging period, it would be an offence to have an exceedence over any 24-hr period; in other words, not just over a calendar day. For the purposes of comparing monitoring data to O. Reg. 419/05 standards, POI guidelines, AAQCs, and Certificate of Approval and Order limits, or for any other contaminant that may cause an adverse effect, the ministry takes the following approach:

1) If a facility is monitoring a pollutant using continuous instrumentation:
   - For a contaminant that has an averaging period of 1-hour or less, 5-minute means should be used to calculate the concentration for the averaging period. For example, the concentration of a contaminant over a half-hour averaging period is calculated by taking the arithmetic mean of any 6 consecutive 5-minute means.
   - For contaminants that have averaging periods greater than 1 hour, hourly means should be used to calculate the concentration for the averaging period. For example, the concentration of a contaminant with a 24-hour averaging period is defined as the arithmetic mean of any 24 consecutive one-hour means.

2) When reporting the number of exceedences, there may multiple consecutive rolling means that exceed a limit. If the consecutive averages occur within a single clock-based averaging period, they are to be reported as a single exceedence. If they are spread across two clock-based averaging periods, they are to be reported as two exceedences, etc.
   a. Example 1: Consecutive half-hour rolling means are noted to exceed at 2:05[1], 2:10 and 2:15. This would be 3-rolling half-hour means that exceed a standard, but they all fall within a single clock-based half-hour period (i.e., 2:00 to 2:30) and are therefore considered to be one exceedence.
   b. Example 2: Consecutive half-hour rolling means are noted to exceed at 2:05 through to 3:15. This would be 15-rolling half-hour means that exceed, but they fall across 2.5 clock-based half-hour periods (i.e., 2:00 to 2:30, 2:30 to 3:00 and 3:00 to 3:30). Therefore three exceedences must be reported.

With respect to Upper Risk Thresholds (URTs), section 30 (3) of O. Reg. 419/05 requires that a person notify the ministry immediately in writing if there is reason to believe, based on any relevant information (e.g., unrefined modelling, refined modelling, monitoring etc.), that discharges of a contaminant may result in the concentration of the contaminant exceeding an upper risk threshold listed in Schedule 6.

Ministry standards, AAQCs and POIs can be found in the documents entitled *Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution* and *Ontario's Ambient Air Quality Criteria*, as amended from time to time. These documents can be found at the following ministry website:

http://www.ene.gov.on.ca/en/air/ministry/index.php

1 Recall from section 2.1 that "time beginning" is used so that a concentration noted at 2:05 is the average concentration of the period from 2:05 to 2:35

2.5.1 Continuous Data

Continuous data will be made available to the ministry in real-time by the emitters in an acceptable manner. With the reliability of current technology and the implementation of a strong preventative maintenance program, automated continuous air quality monitoring systems can achieve a high level of valid data collection. Based on many years of ministry experience with the operation of such systems, a minimum target of 90% valid data collection per quarter per parameter (i.e., at least 1966 hours of valid data out of a total maximum of 2184 hours) can be routinely attained. Emitters and site operators should try to better this objective and meet a desirable target of 95% valid data (at least 2075 hours of valid data out of a total maximum of 2184 hours).

Notwithstanding the minimum 90% valid data performance measure, emitters shall notify, as soon as practical, the ministry of any system or equipment failures resulting in missing data of 24-hours or more in length and of the plans and schedule for repairing the failed system or equipment. This is to be followed by a notification to the ministry when the problems have been resolved and the annual report should detail the events and remedial actions taken.

Quarterly Data Reporting

Raw and validated (edited) data are to be submitted (electronically) quarterly to the ministry in time series Excel or comma separated values (CSV) format as per the guidance in Appendix 3. Prior to the initial submission of data, the ministry must be contacted to initialize the emitter station in the database and to confirm the acceptability of the data format (Appendix 3). The data must be submitted in a 0.5-hr resolution unless another resolution has been agreed upon with the regional ministry office.

The data must be submitted within 45 days of the end of each quarter, based on the calendar year, that is, first quarter by May 15th, second quarter by August 14th, third quarter by November 14th and fourth quarter by February 14th. Edits made to the original data must be summarized in an edit log table, as per the example in Appendix 4, and submitted with the edited data.

The units of measurement for various continuously monitored contaminants are listed in Table 1.

Quarterly Report

A quarterly summary report must be submitted along with the data. Do not include a hard copy of the data with the report. The report shall include the following statistics for each measured pollutant parameter:

- Period Arithmetic Mean
- Monthly Arithmetic Mean
- Maximum for any averaging period used for comparison to statutory or regulatory limits
- Maximum 24-hour
- % valid hours

Table 1: Units of Measurement Associated with Continuously Monitored Parameters

Continuously monitored parameter	Units of measurement	
SO_2, TRS	parts per billion by volume	ppbv
$NO_x/NO/NO_2$	parts per billion by volume	ppbv
Particulate matter (TSP, PM_{10} and $PM_{2.5}$)	micrograms/cubic metre	$\mu g/m^3$
Wind speed[2]	Kilometer per hour	km/hr
Wind direction[1,2]	Degrees clockwise from north	°
Temperature	Degrees Celsius	°C

[1] to be taken as the direction it is blowing *from*, expressed as degrees clockwise from north (i.e., north is 0°/ 360°, east is 90°, etc

[2] to be computed using the equations listed in Appendix 5

Additionally, the report shall include the number times that the emitter exceeded a standard in O.Reg. 419/05, a guideline, an AAQC, a limit in Certificates of Approval or Orders, or any other legal limit which applies to the emitter's facility. The emitter must report all exceedences for each applicable averaging period. This would include, but is not limited to:

- No. half-hour periods > O. Reg. 419/05 half-hour standards or half-hour POI guidelines
- No. 10-minute periods > O. Reg. 419/05 10-min standards
- No. hours > O. Reg. 419/05 hour standards
- No. 24-hour periods > O. Reg. 419/05 24-hour standards
- No. hours > 1-hour AAQCs
- No. 24-hour periods > 24-hour AAQCs
- No. hours > 1-hour thresholds *

*Some regions require notification when concentrations are greater than a threshold. Please contact your regional ministry office if you require additional information.

2.5.2 Non-Continuous Data

Raw and validated data from non-continuous sampling programs are also to be submitted quarterly to the ministry in Excel or CSV format (Appendix 3, Table 10). The units of measurement for various sampled contaminants are listed in Table 2. Data are to be submitted electronically within 45 days of the end of each quarter, based on the calendar year, that is, first quarter by May 15th, second quarter by August 14th, third quarter by November 14th and fourth quarter by February 14th. If full quarter results are not available from the laboratory, supply all data available, and provide missing results in the following quarterly report. The monitoring schedules are specified in the respective SOPs (see Section 4.0). If any data correction was performed, an edit log table shall be submitted as per the example in Appendix 4.

Minimum Routine Scans for Non-Continuous Parameters

The ministry may require minimum routine analytical scans for contaminants of interest or concern such as: metals and/or anions in particulate matter (TSP, PM_{10} and $PM_{2.5}$), speciated VOCs, speciated PAHs, and speciated dioxins and furans. The emitter should contact their

regional office of the ministry during the development of the monitoring plan (Section 1.5) to establish the list of parameters to be analyzed and confirm the required MDLs. Subsequent changes to the parameters list need to be done in consultation with the ministry.

Quarterly Report

A quarterly summary report must be submitted along with the data. These reports should be combined with any continuous data quarterly reports. The report shall include the following statistics for each measured pollutant parameter:

- No. of valid samples
- % valid data
- Period arithmetic mean
- Period geometric mean (TSP only)
- Maximum 24-hour value
- Maximum monthly value

Additionally, the report shall include the number times that the emitter exceeded a standard in O.Reg. 419/05, a guideline, a AAQC, a limit in Certificates of Approval or Orders, or any other legal limit which applies to the emitter's facility. The emitter must report all exceedences for each applicable averaging period. This would include, but is not limited to:

- No. 24-hr periods > O. Reg. 419/05 24-hour standards or 24-hour AAQCs
- No. months > O. Reg. 419/05 monthly standards or monthly AAQCs

Table 2: Units of Measurement Associated with Non-Continuous Samples

Sampled Pollutant	Unit of Measurement	
Dustfall	grams/square metre/30 days	$g/m^2/30d$
Fluoridation rate	micrograms of fluoride/100 square cm/30 days	$\mu g\ F/100\ cm^2/30d$
Particulate matter (TSP, PM_{10} and $PM_{2.5}$) and its constituents	micrograms/cubic metre	$\mu g/m^3$
VOCs	micrograms/cubic metre	$\mu g/m^3$
PAHs	nanograms/cubic metre	ng/m^3
Dioxins/furans (PCDD/PCDF)	picograms/cubic metre expressed in toxicity equivalents	pg/m^3 – TEQ

2.5.3 Annual Reports

By May 15th of each year, the emitters shall provide to the ministry an annual summary report, with interpretation, of the results obtained in the previous calendar year. This report is a summary of annual operations and data, along with interpretation. Do not include a copy of the data with the report. The report shall include:

- A map showing the location of emitting sources, property boundaries, and monitoring stations, including scaling and north arrow.

- A summary of overall operations, e.g., summary of parameters monitored and equipment/model numbers, frequency of site visits and calibrations, confirmation of data backups and/or archiving, list of problems that resulted in significant losses of data along with remedial actions. Do not include copies of station logbook entries.
- A summary of audits and audit outcomes. Do not include copies of the audit reports.
- Summary statistics, including:
  - Annual Arithmetic Mean
  - Annual Geometric Mean (TSP only)
  - Maximum 1-hour (continuous data only)
  - Maximum 24-hour
  - Number of valid hours or sampling periods
  - % valid data
- A summary of exceedences including the number times that the emitter exceeded a standard in O.Reg. 419/05, a guideline, an AAQC, a limit in Certificates of Approval or Orders, or any other legal limit which applies to the emitter's facility. The emitter must report all exceedences for each applicable averaging period. This would include, but is not limited to:
  - Exceedence of annual standard
  - No. months > O. Reg. 419/05 monthly standards or monthly AAQCs
  - No. days > O. Reg. 419/05 24-hour standards or 24-hour AAQCs
  - No. hours > O.Reg. 419/05 hourly standards or 1-hour AAQCs (continuous data only)
  - No. hours > 1-hour threshold * (continuous data only)
  - No. half-hours > O. Reg. 419/05 half-hour standards or half-hour POI guidelines (continuous data only)
  - No. 10-minute periods > O. Reg. 419/05 10-min standards (continuous data only)
- All exceedences of criteria, standards or reporting thresholds are to be evaluated by wind speed/direction data for source contribution assessment: This may include "pollution rose" or "wind rose" analysis for continuous data.
- Comparison to historical data collected by emitters, (preferably using graphics), e.g., comparison of statistics to any previous years' statistics.
- Evaluation of effects (if any) on monitoring results by abatement actions.

*Some regions require notification when concentrations are greater than a threshold. Please contact your regional ministry office if you require additional information.

2.6 Public Reporting of Data

Monitoring data, quarterly and annual reports must be made accessible to the public upon request in a timely and accessible manner.

3. Station and Probe Siting Criteria

This section describes siting criteria applicable to ambient air monitoring stations, probes, samplers and meteorological sensors. It is largely based on the US Code of Federal Regulations[6]. The section also uses siting criteria information from the Environment Canada document entitled *National Air Pollution Surveillance Network Quality Assurance and Control Guidelines*[1]. Criteria for the siting and exposure of meteorological sensors are based on USEPA[7] and World Meteorological Organization (WMO)[8] guidance documents.

Siting criteria are included for monitoring the following parameters: SO_2, TRS, NO_x, particulate matter (TSP, PM_{10}, $PM_{2.5}$ and dustfall), PAHs, VOCs, fluoridation rate and meteorological parameters (wind speed/direction, temperature and solar radiation).

3.1 Station Siting Criteria

Appendix D of the USEPA 1999 document[6] focuses on the relationship between monitoring objectives and the geographical location of monitoring stations. To clarify the nature of this relationship, the concept of spatial scale of representativeness of a monitoring station is defined. The goal in siting stations is to match correctly the spatial scale represented by the sample of monitored air with the spatial scale most appropriate for the monitoring objective of the station. Thus the spatial scale of representativeness is described in terms of physical dimensions of the air parcel nearest to a monitoring station throughout which actual pollutant concentrations are reasonably similar.

The USEPA 1999 document defines scales of representativeness ranging from microscale to national and global scales. For the purposes of ambient air monitoring of emissions from industrial sources, the scales of representativeness will typically range from the microscale to possibly the urban scale. These are defined in the USEPA 1999 document as follows:

Microscale - defines concentrations in air volumes associated with area dimensions ranging from several metres up to about 100 metres;

Middle scale - defines concentrations typical of areas up to several city blocks in size with dimensions ranging from about 100 metres to 0.5 kilometres;

Neighbourhood scale - defines concentrations within some extended area of a city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometres range; and,

Urban scale - defines the overall, citywide conditions with dimensions on the order of 4.0 to 50 kilometres.

These scales of representativeness relate to the following basic monitoring objectives typically associated with monitoring industrial sources of emissions: compliance with regulatory requirements, population exposure and impact of emissions. Air emission inventories, population density, climatological data, geographical/land use information (GIS), dispersion modelling, public complaints about air quality and the results of short-term

screening studies conducted with portable samplers, etc. are all useful in the station site selection process.

3.2 Probe Siting Criteria

Appendix E of the USEPA 1999 document[6] contains specific criteria applicable to locating ambient air monitoring probes after the general station siting has been selected based on the monitoring objectives and spatial scale of representation.

The probe siting criteria discussed below must be followed as closely as possible. It is recognized that practical considerations may require some deviations from the criteria. In such a case, the reasons must be thoroughly documented in a written request for approval by the emitter's district office of the ministry. Conditions under which the ministry may grant a deviation from the criteria will be similar to those listed in section 11 of Appendix E of the USEPA 1999 document.

The following is a description of the probe siting criteria by pollutant of interest for ambient air quality monitoring of emissions from industrial point sources. A summary of the criteria, by pollutant, is also presented in Table 3.

3.2.1 Sulphur Dioxide/Total Reduced Sulphur (SO_2/TRS)

The probe must be located between 3 and 15 metres above ground and must also be at least 1 metre vertically or horizontally away from any supporting structures, walls, parapets, penthouses, etc. Inlet probes protruding from walls are undesirable and are to be avoided. If the probe is located near the side of a building, then it should be on the side of the building facing the point source being monitored. No furnace, incineration flues or other sources of SO_2 should be nearby (separation distance should take into account the height of flues, type of waste or fuel burned and the sulphur content of the fuel).

The distance from obstacles such as walls and buildings must be at least twice the height that the obstacle protrudes above the probe. Airflow must be unrestricted in at least three of four cardinal wind directions, and the direction leading back to the main pollution source being monitored must be unrestricted by obstacles. Since trees can provide surfaces for adsorption or reactions and obstruct wind flow, the probe must be more than 20 metres from trees.

3.2.2 Nitrogen Oxides (NO_2)

The probe must be located between 3 and 15 metres above ground (for middle and neighbourhood scales) and must also be at least 1 metre vertically or horizontally away from any supporting structure, walls, parapets, penthouses, etc. Inlet probes protruding from walls are undesirable and are to be avoided. If the probe is located near the side of a building, then it should be on the side of the building facing the point source being monitored. No furnace, incineration flues or other sources of NO_x should be nearby (separation distance should take into account the height of flues, type of waste or fuel burned).

The distance from obstacles such as walls and buildings must be at least twice the height that the obstacle protrudes above the probe. Airflow must be unrestricted in at least three of four

cardinal wind directions, and the direction leading back to the main pollution source being monitored must be unrestricted by obstacles. Since trees can provide surfaces for adsorption or reactions and obstruct wind flow, the probe must be more than 20 metres from trees.

In siting NO_2 analyzers for industrial point source monitoring, it is important to minimize interferences from automotive sources. For neighbourhood and urban scale monitoring, the table below provides required minimum separation distances between a roadway and a probe for various ranges of daily roadway traffic (smaller separation distances than listed in the table, i.e., less than 10 metres, would classify the monitoring as middle scale).

Minimum Separation Distance (metres)	Vehicles per Day
10	< 10,000
20	15,000
30	20,000
50	40,000
100	70,000
250	110,000

3.2.3 Particulate Matter

Total Suspended Particulate (TSP)

For all spatial scales, the TSP sampler inlet must be between approximately 2 and 15 metres above ground. When determining the sampling location, roadways need to be taken into consideration as TSP has large horizontal and vertical concentration gradients immediately adjacent to roadways. The sampler inlet must be at least 1 metre (vertical) and at least 2 metres (horizontal) from a supporting structure (for a rooftop location, the 2 metre separation distance is from walls, parapets or penthouses located on the roof). No furnace or incineration flues should be nearby.

The distance from the sampler to obstacles such as buildings must be at least twice the height of the obstacle protruding above the sampler. The airflow around the sampler must be unrestricted in three of the four cardinal wind directions. There must be no significant obstruction between the sampler and the point source even though other spacing from obstruction criteria are met. Trees provide surfaces for particulate deposition and also restrict airflow, thus the sampler should be placed at least 20 metres from trees.

To minimize the impact of windblown dusts, the TSP sampler should not be located in an unpaved area unless there is good vegetative ground cover. For ground level installations, it is highly recommended to install the sampler on a stand (0.5 to 1.0 metre above ground) and to direct the exhaust of the sampler away from the sampler using appropriate ducting. Locations near unpaved parking lots, stockpiles or other fugitive sources are to be avoided unless these sources are part of the monitoring objectives. Activities generating particulate emissions, such as grass cutting near the samplers, are to be avoided on sampling dates.

PM_{10} and $PM_{2.5}$ (discrete sampler)

Many of the sample inlet siting criteria are similar to those for TSP sampling, and notwithstanding the differences noted below, the criteria for TSP sampling must be followed.

Since PM_{10} and $PM_{2.5}$ exhibit dispersion properties of both gases and settleable particulates, they show vertical and horizontal gradients. PM_{10} and $PM_{2.5}$ inlets should be placed at breathing height. However, practical factors such as prevention of vandalism, security and safety precautions must also be considered when siting a particulate sampler.

Given these considerations, the sampler inlet height for microscale PM_{10} and $PM_{2.5}$ samplers must be 2-7 metres above ground level. For middle or larger spatial scales, increased diffusion results in smaller vertical concentration gradients than for the microscale, and hence the required air intake is 2-15 metres above ground.

The sampler inlet should be at least 5 metres from the nearest natural gas combustion exhaust. Sampler inlets should be placed at least 25 metres from major roadways to minimize their influence when monitoring industrial sources.

PM_{10} and $PM_{2.5}$ (continuous monitor)

Continuous PM samplers such as the TEOM, Beta Gauge (BAM), etc. require vertical installation of an inlet probe through the roof of the shelter, and according to the instrument operating manual, the sample line must form a straight line with the probe inlet of the sensor unit. Other than this, the probe siting criteria are very similar to those for sampling particulate with discrete samplers: the probe must be located 2 to 15 metres above ground, be at least 1 metre (vertical) 2 metres (horizontal) from support structures and at least 20 metres from trees. The distance from the probe to nearby obstacles such as buildings must be at least twice the height of the obstacle protruding above the probe. Unrestricted airflow is required in three of four cardinal wind directions and the separation distance requirements for discrete particulate samplers from roads and furnace and/or incineration flues apply as well.

Dustfall

The sampling method is described in ASTM Method D1739-98 and also in ministry Method DF-E3043A. Dustfall consists of the very coarse particulate matter fraction that settles quickly under the influence of gravity and can result in soiling and nuisance issues. It may contain components of concern for human health (e.g., lead) and can cause damage to nearby vegetation (e.g., salt cake). Although the sampling method is not considered to be rigorous, some regulatory agencies find it useful to determine off-property impacts of coarse particulate emissions from certain industrial source sectors (e.g., cement, aggregate and primary wood products emitters), and have applicable guidelines/criteria. A copy of Method DF-E3043A is available from the ministry's LaSB, Customer Services at (416) 235-6311. A copy of ASTM Method D1739-98 is available from the ASTM web site at:

www.astm.org

The dustfall sampling method is subject to much interference, such that natural materials (e.g., leaves, insect parts, bird droppings, etc.) not associated with the industrial emissions

being monitored can easily bias the results. Hence, both the lab analytical method and the siting criteria must be followed to meet the objectives of the sampling program.

The dustfall collector (polymer jar) should be held in a suitable bracket affixed to a telephone/electrical utility pole (approval from the local utility should be obtained for everyone's safety) or other supporting device, approximately 3 metres above ground. This vertical separation distance is to minimize re-entrainment of particulate matter from the ground and also to minimize and prevent vandalism. Health and safety concerns regarding the use of ladders to change the jars are best addressed by the use of a long pole equipped with a suitable bracket.

The sampling sites should be selected to avoid unpaved roadways and parking lots, preference being given to sites with good vegetative cover. Also any fugitive source(s) should be documented or preferably avoided through suitable separation distances, depending on the objective of the sampling program. The sampler should be at least 20 metres from buildings, trees and other significant obstacles. There should be unrestricted air flow in three of the four cardinal points, especially between the sampler and the emission source(s) being monitored. For rooftop installations, the sampler should not be near chimneys or flues that could emit soot/coal or other coarse dust and should be positioned away from the edges of the roof to avoid building wake wind effects.

3.2.4 Polycyclic Aromatic Hydrocarbons (PAHs)

Since PAHs in ambient air are associated mostly with fine particulate matter, the sampler inlet siting criteria is the same as for sampling particulate matter. Hence the sampler inlet height must be 3-15 metres above ground and the separation distances from obstacles and furnace/incineration flues etc., is as required for sampling particulate Within the scope of the monitoring objectives, a critical consideration in siting a PAH sampler is to avoid possible nearby PAH sources which could interfere with the sample results. Hence PAH samplers must not be installed on asphalt rooftops and sampling should not be undertaken near sites when rooftop tarring and roadway/parking lot paving activities are occurring.

3.2.5 Volatile Organic Compounds (VOCs)

The sampler inlet siting criteria are the same as for sampling PAHs. Within the scope of the monitoring objectives, care must be taken to avoid nearby VOC sources (e.g., automobile exhaust, furnace/incineration flues, etc.) which could interfere with the sample results. Hence minimum separation distances from roadways, specified for monitoring NO_x, are required.

3.2.6 Dioxins and Furans (PCDD/DF)

The sampler inlet siting criteria are the same as for sampling PAHs and particulate matter. Within the scope of the monitoring objectives, care must be taken to avoid possible known nearby sources of dioxins and furans which could interfere with the sample results. Hence minimum separation distances from such sources, using the range of criteria referenced in this document and knowledge of local conditions are required.

3.2.7 Fluoridation Rate

Sampler siting criteria for the use of lime candles follow the guidelines for siting particulate samplers and trace gas monitors. The candle is usually protected from the elements using a louvered shelter positioned 2 to 3 metres above ground, and it should be located in an area not prone to vandalism. The sampler should be located more than 20 metres from trees and its distance from any air flow obstacle must be greater than twice the height of the obstacle above the sampler. There should be unrestricted air flow in three of the four wind quadrants.

Within the scope of the monitoring objectives, care must be taken to try to avoid possible known nearby sources of fluorides which could interfere with the sample results. Hence minimum separation distances from such sources, using the range of criteria referenced in this document and knowledge of local conditions are required. The sampling method is described in ASTM Method D3269-96 (2001) e1 which is available at the following URL:

www.astm.org

Table 3: Sample Probe Siting Criteria

Pollutant	Height Above Ground (metres)	Distance from Supporting Structure (metres)		Other Spacing Criteria
		Vertical	Horizontal[1]	
SO_2 and TRS	3 to 15	>1	>1	a. >20 metres from trees b. Distance from the sampler to any air flow obstacle, i.e., buildings, must be >2x height of obstacle above the sampler c. Unrestricted air flow in 3 of the 4 wind quadrants d. No nearby[2] furnace or incineration flues
Nitrogen Oxides (NO_2) (middle scale)	3 to 15	>1	>1	a. >20 metres from trees b. 10 metres from street intersection or at mid-block location c. >2-10 metres from roadway
Nitrogen Oxides (NO_2) (neighbourhood scale)	3 to 15	>1	>1	a. >20 metres from trees b. Distance from the sampler to any air flow obstacle, i.e., buildings, must be >2x height of obstacle above the sampler c. Unrestricted air flow in 3 of the 4 wind quadrants d. Spacing from roadway varies with road traffic e. No nearby furnace or incineration flues
TSP (both spatial scales)	2 to 15	>1	>2	a. >20 metres from trees b. Distance from the sampler to any air flow obstacle, i.e., buildings, must be >2x height of obstacle above the sampler c. Unrestricted air flow in 3 of the 4 wind quadrants d. No nearby furnace or incineration flues e. Distance of sampler from major roadways should be > 20-25 metres for sampler inlet heights of 2 to 5 metres
PM_{10} and $PM_{2.5}$ (discrete sampler)	2-7[3] 2-15[4]	>1 >1	>2 >2	a. >20 metres from trees b. Distance from the sampler to any air flow obstacle, i.e., buildings, must be >2x height of obstacle above the sampler c. Unrestricted air flow in 3 of the 4 wind quadrants

Table 3: Sample Probe Siting Criteria

Pollutant	Height Above Ground (metres)	Distance from Supporting Structure (metres)		Other Spacing Criteria
		Vertical	Horizontal[1]	
				d. >5 metres from chimneys with natural gas combustion emissions e. >20-25 metres from major roadways
PM_{10} and $PM_{2.5}$ (continuous sampler)	2 to 15	>1	>2	a. >20 metres from trees b. Distance from the sampler to any air flow obstacle, i.e., buildings, must be >2x height of obstacle above the sampler c. Unrestricted air flow in 3 of the 4 wind quadrants d. >5 metres from chimneys with natural gas combustion emissions e. >20-25 metres from major roadways
PAHs/Dioxins VOCs	3 to 15	>1	>2	a. No nearby sources of PAHs, dioxins and VOCs which could interfere with sample results
Dustfall	3			a. No nearby unpaved roadways, parking lots[5] b. >20 metres from obstacles (buildings, trees) c. Unrestricted air flow in 3 of the 4 wind quadrants d. No nearby chimneys or flues that could emit coarse particulate (soot/coal) e. Avoid building wake wind effects for rooftop installations

[1] When a probe is located on a rooftop, this separation distance is in reference to walls, parapets, or penthouses located on the roof

[2] Distance depends on the height of furnace or incinerator flues, type of waste or fuel burned, and quality of fuel (sulphur and ash content). This is to avoid undue influence from nearby sources

[3] For microscale measurements

[4] For middle or larger scale measurements

[5] Separation distances from these sources depend on monitoring objectives

3.2.8 Probe Material

In addition to the siting criteria for stations and sample inlet probes, an important requirement is the use of acceptable probe materials. For reactive gases such as SO_2 and NO_2, only Pyrex glass and FEP Teflon have been found to be acceptable for use as intake sampling lines. For VOC sampling, FEP Teflon is unacceptable because of VOC adsorption and desorption reactions on the Teflon. Acceptable probe materials for VOC sampling are borosilicate glass, stainless steel or its equivalent.

3.2.9 Meteorological Measurements

The meteorological sensor siting and exposure criteria described below are largely based on USEPA and WMO guidance documents[7,8] as referenced. Meteorological measurements include measurements of wind speed, wind direction, temperature, barometric pressure, relative humidity and solar radiation. This document will not cover barometric pressure and relative humidity. As a general rule, meteorological sensors should be sited at a distance, which is beyond the influence of obstructions such as buildings and trees. The other general rule is that the measurements should be representative of meteorological conditions in the area of interest. A summary of the criteria for siting meteorological probes is provided in Table 4.

Wind Speed and Direction

To meet the best exposure criteria, sensors to measure wind are usually mounted on towers or masts. If sensors are mounted improperly, errors due to the influence of nearby obstacles and possibly of the tower itself will be introduced into the measurements.

Except when measurements of extremely local phenomenon are required (from microscale to neighbourhood scale), measurements representative of a fairly large area (urban to regional scale) are desired. Care must be taken to ensure that the measurements are not adversely influenced by nearby obstacles. The WMO has recommended that the standard height at which surface wind measurements should be taken is 10 metres (however measurements at a height of 2 metres are acceptable for tripod-mounted sensors). Depending on the monitoring objectives/requirements, there may be circumstances for which wind measurements would best be taken at elevations much higher than 10 metres (minimize topographical effects, tracking of emissions from tall stacks, etc.). Such cases would need the approval of the ministry. Ideally, the measurements should be taken over level, open terrain but if obstructions, such as buildings, are present in the area where wind measurements are to be taken, the following criteria must be observed:

a) The sensor must be located a distance upwind of a building equal to at least the building height.

b) If the sensor is to be located on the roof of the building, it must be at least one and a half (1.5) building heights above the roof. Wind sensors should only be located on building rooftops as a last resort.

c) The sensor must be located a distance of at least 5 to 10 building heights downwind of the building.

For rough terrain or valley situations, local effects such as channelling, slope and valley winds need to be considered in the design of the monitoring program. If the program focuses on elevated sources of emissions, it may be desirable to avoid local wind influences. If the emissions of interest are from ground level sources, local influences require careful consideration and the siting of the wind sensors must take into account nearby topographical features, which could unduly influence the measurements.

In addition to the general rules concerning obstructions, other considerations are important with respect to sites near trees. Seasonal effects need to be considered for sites near deciduous trees. For dense continuous forests where an open exposure cannot be obtained, measurements should be taken 10 metres above the height of the general vegetative canopy.

If the anemometer and vane are to be installed on the side of a tower, then precautions must be taken to ensure that the wind measurements are not influenced by the tower. Studies have shown that turbulence in the wake of lattice towers is severe and in the wake of solid towers turbulence is extreme, often with flow reversal. Open lattice towers are preferred. To mitigate these effects, the following exposure criteria should be observed:

a) The boom should extend outward from a corner of the tower into the wind direction of primary concern
b) The boom should place the sensor out from the tower a distance not less than the length of a side of the tower
c) The wind sensors should be located at heights of minimum tower density, above or below the horizontal cross members
d) If the width of the tower side is D, for a boom length of 1 tower width, i.e., 1D, measurements of wind speed are true to within 10% for a 330^{o} sector of arc
e) For a boom length of 2D, wind speed is accurate to within 10% for a 330^{o} sector of arc. It is recommended that the wind sensor be mounted on booms at a distance of at least 2D from the tower

For these two arcs, wind direction has been found to be accurate to within 5%. On large TV towers, the sector of arc yielding accurate wind measurements may drop to 180^{o} for boom lengths less than 1D. If more accurate wind measurements are required for an arc greater than that produced by the above exposure criteria, it is recommended that two sets of speed and direction sensors be placed 180^{o} apart in the manner prescribed above. A wind sensor mounted on top of a tower should be mounted at least 1D above the top of the tower structure.

Air Temperature

The sensor must be housed in a ventilated radiation shield (aspiration velocity should exceed 3m/s) to protect the sensor from thermal radiation. The USEPA recommends the sensor be

no closer than four times the obstruction's height and at least 30 metres from large paved areas. Other situations to avoid include: large industrial heat sources, rooftops, steep slopes, tall vegetation, shaded areas, swamps, etc. The WMO standard for ambient air temperature measurements is 2 metres above ground. The USEPA recommends that the sensor be located at least 2 metres above ground, up to a maximum of 10 metres. Vandalism and security need to be considered in the placement of these sensors. Temperature sensors on towers should be mounted on booms at a distance of about 1D (D is the width of the tower side).

Probe placement for temperature difference measurements depend on the application. For use in estimating stable plume rise, temperature difference measurements should be made across the plume rise layer and a minimum separation of 50 metres is recommended.

Solar radiation

Pyranometers used for measuring incoming solar radiation should be located with an unrestricted view of the sky in all directions during all seasons, with the lowest solar elevation angle possible. Sensor height is not critical for these units. A tall platform or rooftop is a desirable location.

Net radiometers should be mounted about 1 metre above ground and in such a fashion as to avoid obstructions to the field of view both upward and downward. The ground cover should be representative of the general site area. The monitoring objective will govern the collection of solar or net radiation data.

Table 4: Meteorological Probe Siting Criteria

Sensor Type	Height Above Ground (metres)	Exposure Considerations
Wind speed and direction	10[1]	a. >1 building height (H) upwind of a building obstruction b. >1.5H above building roof for rooftop installation[2] c. >5-10H downwind of building d. >10 metres above dense vegetative canopy e. >2 tower side widths (D) for boom installations f. >1D above tower for tower mast installation
Air temperature	2[1]	a. Temperature sensor >4 obstruction heights and >30 metres from large paved areas b. >1D for tower boom installations c. >50 metres between levels for temperature difference measurements
Solar radiation	1[3]	a. No vertical height restriction for pyranometers (incoming solar radiation) b. Ground cover representative of area

[1] World Meteorological Organization recommendation; height can be greater depending on monitoring requirements (e.g., tall stacks)

[2] Rooftop installations not recommended

[3] Height above ground for net radiometers

4. Standard Operating Procedures (SOPs)

The SOPs provided in this section for performing ambient air quality monitoring are, generally, those currently used by the ministry. The current listing is the first revision to the initial list provided in June 2003. Most of the methods described herein have been designated as reference or equivalent methods by the USEPA. A current listing of these methods, for criteria air contaminants, can be found at the following USEPA web site:

http://www.epa.gov/ttn/amtic/criteria.html

For the air contaminants described as air toxics by the USEPA, such as PAHs, VOCs and dioxins/furans, the methods recommended by the USEPA, and accepted by the ministry, are available at the following USEPA web site:

http://www.epa.gov/ttn/amtic/airtoxpg.html

It is important to note that the SOPs are not intended to provide a detailed description of the monitoring/sampling methods. Emitters and site operators will need to review the method reference documents for the detailed method descriptions.

Emitters/site operators using or wanting to use an air monitoring or sampling method not listed in these SOPs, and not designated or listed by the USEPA, must contact their regional office of the ministry at the program planning stage for approval of the method intended to be used.

The SOPs are short documents which provide emitters and site operators with information on reference documents, the acceptable monitoring method(s), any additional equipment required, and instrumentation QA/QC requirements such as the type of internal/external performance checks and calibrations, and the performance audits by the ministry. The requirements specified in these documents are minimum requirements and site operators are encouraged to exceed them if desired for optimal performance. The operators of the instrumentation are required to service, operate and maintain it in accordance with the manufacturer's operating manual.

The SOPs will be revised from time to time to reflect changes and the introduction of new technology for air monitoring/sampling methods and updated QA/QC requirements.

4.1 Standard Operating Procedure for Editing Continuous Data

This SOP establishes the procedure by which data editing will be conducted. It is intended to:

- Standardize the method by which data editing is done
- Ensure consistency of application
- Clearly define the expectations of the process

4.1.1 Daily Data Check

1. Every weekday a daily data review should be conducted to check for anomalous data.

2. Instruments that do not appear to be functioning normally are to be investigated and simple problems rectified. If major problems are noted by others they are referred to the person assigned to that station.

3. Data is reviewed and corrections made where possible. Significant problems are flagged to the person assigned to that station (if problem noted by another person) if it appears related to a station related function that may need correcting.

4.1.2 Data Editing

All data should be edited within 30 days of the end of the month in which it was collected.

Data editing is any change made to raw data. It includes a check of the data and typically involves manual verification of values against electronic charts or other secondary data log(s) (e.g., minute data) and changing data to recover missing values, invalidating false data, etc. To maintain edited data as current as possible, the following procedure should be carried out after each calibration or as a minimum, monthly.

From a DAS workstation, print a monthly data report and review data looking for anomalous readings or missing data. Highlight data or data blocks that will require editing. See Table 5 below for the general principles to ensure valid data.

Table 5: General Principles for Data Editing - Continuous Data

Parameter	Look For	Action
General	Preponderance of missing values	Perform Manual Poll to recover missing data. Check other parameters for interruption, if yes may be power failure
	Extreme high value(s)	Check data logger configuration Check minute data
	Values look correct for pollutant	No action required
	Checking calibration reports	Ensure zero and span response not shifting much.
NO_x	Channels balance $NO + NO_2 = NO_x$	Not every hour will balance but majority should
	Channels not adding up at all	Zero reset may be needed
	Long periods of zeros	Station visit; possible flow problem
TRS	Single hourly value too high (or low) compared to adjacent readings	View minute data and correct Verify span check
	String of unchanging elevated numbers	Check wind direction and speed. Apply negative offset if required. Check for SO_2 breakthrough
	Consistent low level values	Baseline noise; adjust block to zero
	Oxidizer temperature not within specifications, typically between 850^0C - 915^0C	Invalidate data for time period of failure. Note: site visit maybe required to verify no connection problem (if connection ok, invalidation not required)

Parameter	Look For	Action
SO_2	Same as TRS	
Ambient Temperature	Check temperature readings for extreme high or low values. Check for long periods of constant values	View minute data and correct. Check for power failures. Check for defective temperature probe.
PM PM_{10}/ $PM_{2.5}$	Filter loading greater than 90% String of zeros for PM_{10}/$PM_{2.5}$ Mass concentration and PM_{10}/$PM_{2.5}$	Site visit to change filter (TEOM) Check whether statuses are within range Values for the same hour should be very close; if values seem to be offset by one hour, check treatment settings
Wind	Check for some readings >20 kph Long periods of calm or same wind direction	Aerovane turning ok? Is aerovane stuck or frozen?
Any other continuously monitored parameter		Establish data editing principles in consultation with local district office of the ministry.

4.2 Standard Operating Procedure for Editing Non-Continuous Data

This SOP establishes recommended procedures by which data validation and editing will be conducted for non-continuous data. It is intended to:

- Standardize the method by which data editing is done
- Ensure consistency of application
- Clearly define the expectations of the process

A summary of the standard sampling schedules and general data editing and completeness requirements was provided earlier in section 2.4. Table 6 outlines in greater detail the general principles of data validation and editing to ensure the collection of good data.

Validation and editing of non-continuous data comprises procedures to be followed during sample collection and handling in the field, submission to a laboratory, laboratory analyses and analysis/screening of the data as part of the final editing process.

4.2.1 Field Procedures - sample collection and submission to a laboratory

The collection of valid field samples is the first step in ensuring the production of valid data. Air monitoring station operators should follow the Standard Operating Procedures provided in Section 4.3 and the principles outlined in Table 6. To assist operators in the collection of TSP and PM_{10} samples, please refer to the ministry document *A Guide to Air Filter (hi-vol and PM_{10}) Sampling and Submission* which is available through your local ministry office.

Generally speaking, field operators should invalidate samples which are highly suspect. For example, every exposed TSP or PM_{10} filter should show some discolouration; a filter which is as white as an unexposed filter suggests that the sampler motor did not run or ran for a very brief time. It is very important for field operators to document their observations at the time of sample collection to assist in the data validation process: a lightly discoloured filter would suggest a possible error in the determination of its tare weight in the laboratory if the particulate loading result was determined to be very high. These observations should be documented in writing and forwarded to the laboratory together with the sample.

Care is also required in shipping samples to the laboratory. Suitable containers are required to avoid sample contamination, destruction, damage, etc. Also, some samples such as VOCs, need to be kept and stored between 2°C and 10°C until the analysis is performed. Other samples, such as filters exposed for PAH analysis, need to be sent to the laboratory within 14 days of sampling. Filters exposed for dioxin and furan analysis need to be kept in the dark to avoid sample degradation.

It is important for field operators to be familiar with, and follow, the recommended sample collection and handling procedures as closely as possible. Field operators must also document their observations for use by laboratory and data management staff in the data validation process.

4.2.2 Data screening and analysis

Another important component of the data validation process is data screening and analysis by staff responsible for data management aspects. Screening criteria are commonly used to flag or identify suspicious data. This comprises identifying outliers (extreme high or low values not commonly observed or possible, such as TSP or PM_{10} values < 0 or > 500 $\mu g/m^3$, or benzene, toluene and xylenes values all < 1 $\mu g/m^3$), or identifying results which are not theoretically possible such as PM_{10} > TSP for collocated samplers. Data analysts can design their own screening criteria to check suspicious data, based on their experience and knowledge of the database for the parameters of interest.

4.2.3 Analytical data screening and analysis

The third aspect of the data validation process involves laboratory screening procedures. For example, the determination of TSP, PM_{10} and $PM_{2.5}$ particulate loadings involves weighing the filters in a temperature and humidity controlled room before and after the filters have been exposed. An obvious check here is to ensure that the exposed filter weight is greater than the tare filter weight. If this is not the case, this could result from a weighing error in the lab, a transcription error or a damaged exposed filter for which a small piece of filter is missing. Samples which require analysis within a time period after collection or receipt in the laboratory, known as sample hold time, may be analyzed but the result qualified with a remark if this time period has been exceeded. The decision as to whether or not the result is valid will have to be made based on all the information available for that sample.

Typically, laboratories use QA/QC control limits which are quite rigorous and if properly followed should uncover suspicious results. Analytical methods specify strict procedures for sample preparation/storage, sample hold times and expected method performance such as accuracy, precision and detection limits. Analytical data validation is closely linked to how well these methods are adhered to.

In summary, these examples are only a few of many that could be provided to screen out suspicious or invalid data. There should be good communication and documentation of observations by all staff involved in the process. Table 6 provides additional information on recommended checks and actions required to assist in the data validation process for non-continuous data. If in doubt about how to handle suspect data, consult with regional ministry personnel.

Table 6: General Principles for Data Validating and Editing -Non-Continuous Data

Parameter	Look For	Action
Dustfall	Siting criteria Exposure period	Regularly inspect site and surrounding area to ensure criteria continue to be met. Check 'on' and 'off' dates to confirm period is within 5 days of start and end of calendar month and exposure period is between 25 and 35 days; ensure sample identified with proper exposure month
	Condition of jar/liner	Check for signs of vandalism/tampering; ensure integrity of both and ensure that sample has not leaked due to liner tear/breakage
	Sample condition	Inspect to determine possible contamination by interfering materials (e.g., excessive algae growth, bird droppings, other significant objects/materials)
	Sample storage/submission	Minimize storage period and refrigerate if sample submission to lab is to be delayed for some time; ensure plastic liner is well sealed for shipment to lab
	Data outliers	Check for extreme values (high and low) and investigate to confirm
	Identical results for consecutive months	Check 'on' and 'off' dates
Fluoride candles	Siting criteria	Inspect site and surrounding area to ensure criteria continue to be met
	Candle container	Check to ensure container has not been opened prior to candle being exposed in the field
	Exposure period	Check 'on' and 'off' dates to confirm period is within 5 days of start and end of calendar month and exposure period is between 25 and 35 days; ensure sample identified with proper exposure month
	Shelter and candle condition	Check for signs of vandalism/tampering; ensure top of louvered shelter is down and candle not exposed to precipitation; check for good air flow through the louvers (no obstructions)
	Sample storage/submission	Minimize storage period after exposure; ensure candle container is well sealed for shipment to lab
	Data outliers	Check for extreme values (high and low) and investigate if required
	Identical results for consecutive months	Check 'on' and 'off' dates
TSP, PM_{10}, $PM_{2.5}$, PAHs	Siting criteria	Inspect site and surrounding area to ensure criteria continue to be met
	Filter and filter condition	Check filter integrity (perforations, missing pieces, large cracks, etc.); avoid contamination of exposed filter surface area while handling; exposed filter should always be darker than new filter

Parameter	Look For	Action
	Filter cassette	Check for integrity and cleanliness of screen, gasket (tight seal on filter)
	Shelter condition	Check for signs of vandalism/tampering; check for accumulated particulate and clean according to manufacturer's instructions (especially significant for the PM_{10} and $PM_{2.5}$ size selective inlet head cyclones)
	Flow controller and timer	Check for proper sampling run times and flow rate
	Handling of exposed filter	Remove from the sampler as soon as practical. Fold and store filter in acceptable envelope (TSP), cardboard folder (PM_{10}), or aluminum foil (PAHs); refrigerate the filters for PAH analysis and minimize their exposure to fluorescent light -these filters should be analyzed within 7 days of exposure PAH filter samples should not be handled with bare hands unless they have been cleaned.
	PUF plug cartridge container	Ensure container is intact (wrapped in Al foil) and sealed prior to sampling run; ensure plug is re-inserted in the glass container with original aluminum foil, the container is sealed and shipped to the lab for analysis
	47 mm filter ($PM_{2.5}$)	Transport and expose the filters in the specially designed filter cassettes and store these in plastic Petri dishes or cassette holders. The filters should only be loaded/unloaded in the cassette rings in the lab by lab staff where they weighed
	Data outliers	Check for extreme values (high and low) and investigate to confirm; filter tare weight should always be less than weight of exposed filter
	TSP vs PM_{10} and $PM_{2.5}$	For collocated sites, check that TSP always greater than PM_{10} and $PM_{2.5}$
VOCs	Cartridge container	Ensure glass container still sealed, intact and refrigerated prior to exposure of cartridge
	Flow controller and timer	Check both to ensure proper flow rate and sampling time
	Exposed cartridge	Remove cartridge from sampler as soon as practical, follow proper storage/ refrigeration requirements and ship to lab for analysis within required time frame after exposure
	Evacuated canister	Ensure the initial vacuum in the canister is -29 ± 3 in of Hg and that when not in use the flow controller inlet and outlet are always capped. After the 24 hour sampling period, the final canister pressure should be between -5 to -10 in of Hg with a flow controller set at 3.5 mL/min for a 6 litre canister.

Parameter	Look For	Action
	Data outliers	Check for unusual and extreme values (especially high) and investigate to confirm
Dioxins and furans	Same as TSP, PM_{10} and PAHs	
	PUF plug cartridge container	Ensure container is intact (wrapped in aluminum foil) and sealed prior to sampling run; ensure plug is re-inserted in the glass container with original aluminum foil, the container is sealed and shipped to the lab for analysis
	Data outliers	Check for unusual and extreme values and investigate to confirm
Any other sampled parameter		Establish data editing principles in consultation with local District Office of ministry.

4.3 Standard Operating Procedures for Air Quality Monitoring

Sulphur Dioxide (SO_2)

POLLUTANT	**Sulphur Dioxide (SO_2)**
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf Automated equivalent method
REFERENCE DOCUMENTS	USEPA TTNWEB (current listing) http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf
METHOD	Ultraviolet (UV) Fluorescent
OPERATION, SERVICE AND MAINTENANCE	
Operation, service and maintenance of the analyzers should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned. Data is to be collected in standard time (EST or CST as determined by local usage).	
ADDITIONAL EQUIPMENT REQUIRED	
•Inlet line particulate filter (5 micron TFE filter element) •Remote activation of zero / span and sample valves •Zero / span and sample solenoid valves •Internal permeation span source, SO_2 permeation tube, uncertified •Certified SO_2 calibration unit	
INSTRUMENTATION QA/QC REQUIREMENT	
INTERNAL PERFORMANCE CHECK	Daily (over a 24-hour period)
DESCRIPTION*:*	
Internal performance check is defined as a QA/QC procedure carried out within the analyzers. Internal zero and span checks are to be performed automatically once per day. These checks are required to assess on-going instrument performance such as zero / span drift, sample repeatability and response time and to ensure adherence to ministry QA/QC and reporting practices.	

REQUIREMENT*:*
Automatic internal zero / span checks are to be performed daily. The total calibration cycle should run over two 1-hour periods (i.e., be initiated at the end of an hour and to carry over in the beginning of the next hour) to avoid lost data as a result of the required duration of the calibration cycle. The total calibration period is to be approximately 20 minutes, preferably commencing at 00:50 hours each day (or at 50 minutes into another hour if more suitable or desirable) and consisting of a 5 minute zero, 10 minute span and 5 minute recovery. Zero and span values should be reviewed daily.

Note: Auto span adjustment is not recommended

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Monthly

DESCRIPTION:
An external performance check and calibration is defined as a QA/QC procedure carried out with a **certified** calibration unit (e.g., calibrator, gas cylinder, etc., referenced to a primary standard). Ministry will **certify** calibration unit annually.

REQUIREMENT*:*
An external performance check and calibration is to be carried out by the operator at least once per month and before (e.g., span drift of 5% or more) the internal performance check shows that the span values are greater than ±10% of the known standard. External performance checks are also recommended to be done after repairs are made to an analyzer, when an analyzer is installed at a station and **possibly** after a pollution episode. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. Calibration equipment will be **verified** by the ministry at least once per year.

AUDIT	Four times per year

DESCRIPTION:
An audit will be performed by the ministry at least four times per year. It will also periodically include a check of the data flow through the telemetry system.

REQUIREMENT:
Corrective action (e.g., zero and/or span adjustments, analyzer response time, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non-conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Total Reduced Sulphur (TRS)

POLLUTANT	Total Reduced Sulphur (TRS)
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods - most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf Equivalent reference method (SO_2)
REFERENCE DOCUMENTS	USEPA TTNWEB (current listing) http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf
METHOD	USEPA approved U.V. Pulse Fluorescent (SO_2) with high temperature oxidizer

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURER OPERATING MANUAL unless otherwise mentioned. Data is to be collected in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

- High temperature oxidizer (850°C to 915°C) with SO_x scrubber
- Inlet line particulate filter (5 micron TFE filter element)
- Remote activation of zero / span and sample valves
- Zero/span and sample solenoid valves
- Internal permeation span source, H_2S permeation tube, uncertified
- Certified SO_2 calibration source and certified H2S calibration source

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	Daily

DESCRIPTION*:*
Internal performance check is defined as a QA/QC procedure carried out within the analyzer. Internal zero and span checks are to be performed automatically once per day. These checks are required to assess on-going instrument performance, such as zero/span drift, sample repeatability and response time and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT*:*
Automatic internal zero / span checks are to be performed daily. The total calibration cycle should run over two 1-hour periods (i.e., be initiated at the end of an hour and carry over into the beginning of the next hour) to avoid lost data as a result of the required duration of the calibration cycle. The total calibration period is to be approximately 20 minutes, preferably commencing at 00:50 hours each day (or at 50 minutes into another hour if more suitable or desirable) and consisting of a 5 minute zero, 10 minute span and 5 minute recovery. Zero and span values should be reviewed daily.

Note: Auto span adjustment is not recommended

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Monthly

DESCRIPTION:
An external performance check and calibration is defined as a QA/QC procedure carried out with a **certified** calibration unit (e.g., calibrator, gas cylinder, etc., referenced to a primary standard). Ministry will **certify** the TRS calibration unit annually.

REQUIREMENT*:*
An external performance check and calibration is to be carried out by the operator at least once per month and before (e.g., span drift of 5% or more) the internal performance check shows that the span values are greater than ±10% of the known standard. External performance checks are also recommended to be done after repairs are made to an analyzer, when an analyzer is installed at a station and **possibly** after a pollution episode. The instrumentation must be challenged periodically with a **certified** SO_2 gas source (at least 100 ppb) to ensure proper operation of the SO_x scrubber and to provide guidance as to when to change the scrubber. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. Calibration equipment will be **verified** by the ministry at least once per year.

AUDIT	Four Times per year

DESCRIPTION:
An audit will be performed by the ministry at least four times per year. It will also periodically include a check of the data flow through the telemetry system.

REQUIREMENT:
Corrective action (e.g., zero and/or span adjustments, analyzer response time, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non-conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Nitrogen Dioxide

POLLUTANT	**Nitrogen Dioxide (NO_2)**
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf Manual equivalent method
REFERENCE DOCUMENTS	USEPA TTNWEB (current listing) http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf
METHOD	Chemiluminescence

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzers should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned. Data is to be collected in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

- Inlet line particulate filter (5 micron TFE filter element)
- Remote activation of zero/span and sample valves
- Zero/span and sample solenoid valves
- Internal permeation span source: NO_2 permeation tube or an NO cylinder (both uncertified)
- Certified NO and NO_2 calibration unit

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	Daily

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the analyzers. Internal Zero and Span checks are to be performed weekly. These checks are required to assess on-going instrument performance such as zero / span drift, sample repeatability and response time and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Manual zero / span checks are to be performed weekly. The total calibration cycle should run over two 1-hour periods (i.e., initiated at the end of an hour and carried over into the beginning of the next hour) to avoid lost data as a result of the required duration of the calibration cycle. The total calibration period is to be approximately 20 minutes, preferably commencing 50 minutes into the hour and consisting of a 5 minute zero, 10 minute span and 5 minute recovery.

Note: Auto span adjustment not recommended

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Monthly

DESCRIPTION:
An external performance check and calibration is defined as a QA/QC procedure carried out with a **certified** calibration unit (e.g., calibrator, gas cylinder, gas dilution system, etc., referenced to a primary standard). Ministry will **certify** the gas calibration unit annually.

REQUIREMENT:
An external performance check and calibration is to be carried out by the operator at least once per month and before (e.g., span drift of 5% or more) the internal performance check shows that the span values are greater than ±10% of the known standard. External performance checks are also recommended to be done after repairs are made to an analyzer, when an analyzer is installed at a station and **possibly** after a pollution episode. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. Calibration equipment will be **verified** by the ministry at least once per year.

AUDIT	Four Times per year

DESCRIPTION:
An audit will be performed by the ministry at least four times per year. It will also periodically include a check of the data flow through the telemetry system.

REQUIREMENT:
Corrective action (e.g., zero and/or span adjustments, analyzer response time, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Total Suspended Particulate (TSP)

POLLUTANT	Total Suspended Particulate (TSP)
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf Designated reference method
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf 40 CFR Part 50 Appendix B, Vol 47 & 48 A Guide To Air Filter (TSP and PM_{10}) Sampling and Submission, Ministry of the Environment, May 2003
METHOD	High Volume Sampler (hi-vol)

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise stated. Sampler to operate every 6th day on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Samples to be collected over a 24-hour period from midnight to midnight (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

- Appropriate filter for parameters to be analyzed: 8" by 10" in size
- Flow controller capable of maintaining a flow of 40 cfm (± 4 cfm) over 24 hours
- Certified flow calibration device

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	At each filter changeover (every 6th day if on a 6 day schedule)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed manually at each filter changeover. These checks are required to assess routine instrument performance such as proper flow controller operation and confirmation of the correct time, date and sampling date on the flow controller/timer, and to ensure adherence to ministry QA/QC and reporting

practices.
REQUIREMENT: These checks include visual inspection of the sampler, a check of the flow controller to ensure that the flow is being maintained (controller alters the motor speed to maintain a constant flow rate) and confirmation of the correct time of day (EST or CST as determined by local usage), correct sampling day and duration (24 hours). Periodically, a check should be performed of the ΔP from the pressure tap on the motor casing with a digital manometer to confirm that the ΔP is in the expected range.

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Quarterly
DESCRIPTION: External performance check and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.	
REQUIREMENT: An external performance check and flow calibration is to be carried out by the operator quarterly and before (e.g., flow deviation of ± 5% or more of 40 cfm) the internal performance check shows that the flow is greater than ± 10% of the required flow (40 cfm). The calibration must be done in accordance with the procedures described in the reference documents, specifically the *Ministry of the Environment Guide to Air Filter (TSP and PM_{10}) Sampling and Submission, May 2003.* The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified against a reference or transfer standard traceable to recognized national primary standards.	

AUDIT	Twice per year
DESCRIPTION: An audit will be performed by the ministry at least twice per year.	
REQUIREMENT: Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non-conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.	

Inhalable Particulate (PM_{10}) – Discrete Samplers

POLLUTANT	Inhalable Particulate Matter (PM_{10})
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria reference-equivalent-methods-list.pdf
REFERENCE DOCUMENTS	http://www.epa.gov/EPA-AIR/1997/July/Day-18/a18577c.htm 40 CFR Part 50 Vol 62 Appendix M A Guide To Air Filter (TSP and PM_{10}) Sampling and Submission, Ministry of the Environment, May 2003
METHOD	High Volume Sampler (hi-vol) equipped with size-selective head for PM_{10}

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned. Sampler to operate every 6th day on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Samples to be collected over a 24-hour period from midnight to midnight in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

Appropriate filter for parameters to be analyzed: 8" by 10" in size
Flow controller capable of maintaining a flow of 40 cfm (± 4 cfm) over 24-hours
Certified flow calibration device

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	At each filter changeover (every 6th day if on a 6 day schedule)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed manually at each filter changeover. These checks are required to assess routine instrument performance such as proper flow controller operation and confirmation of the correct time, date and sampling day on the flow controller/timer, and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:

These checks include visual inspection of the sampler, a check of the flow controller to ensure that the flow is being maintained (controller slows down the motor rpm to maintain a slower rpm) and confirmation of the correct time of day (EST or CST as determined by local usage), correct sampling day and duration (24 hours).

Periodically, a check should be performed of the ΔP from pressure tap on the motor casing with a digital manometer to confirm that the ΔP is in the expected range.

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Quarterly

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An external performance check and calibration is to be carried out by the operator quarterly and before (e.g., flow deviation of ± 5% or more of 40 cfm) the internal performance check shows that the flow is greater than ± 10% of the required flow (40 cfm). The calibration must be done in accordance with the procedures described in the reference documents, specifically the *Ministry of the Environment Guide to Air Filter (TSP and PM_{10}) Sampling and Submission, May 2003.* The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit will be performed by the ministry at least twice per year. The calibration equipment will be **verified** by the ministry at least once per year.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Beta Attenuation Monitor (BAM) Model 1020 (PM_{10})

Met One Instruments, Inc.

POLLUTANT	**Inhalable Particulate Matter (PM_{10})**
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf EQPM-0798-122 (Aug. 1998)
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/files/cfr/recent/pm10des pdf http://www.epa.gov/epahome/cfr40.htm 40 CFR Part 53 40 CFR Part 50, Appendix J Operating Manual, BAM-1020-9800 Rev E

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should be in accordance with the instrument manufacturer's operation manual and with the applicable requirements specified in 40 CFR Parts 50 and 53. Samplers to use a glass fiber filter tape with a minimum filter advance frequency of one hour (on the hour) and operated for 24-hour mean measurements.

Note: The designated method requires that the system must be operated on a PM_{10} concentration range of 1.0 mg/m^3 and a sample pump time of 50 minutes. The unit may also be operated with $PM_{2.5}$ or TSP sampling heads, but has not been certified as a manual equivalent method by the USEPA for monitoring those components.

ADDITIONAL EQUIPMENT REQUIRED

•Glass fiber filter tape, 2.0 µm pore size
• Zero calibration kit (BX-302); flow calibration inlet adapter (BX-305)
• Certified flow (e.g., BIOS, BX-307 or TriCal), temperature, barometric pressure and relative humidity calibration devices.

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	At each filter paper tape changeover (every 2 months) or preferably every month.

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler by the operator. Internal checks are to be performed manually at each filter changeover or preferably every month. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Internal performance checks are to be performed at every filter tape changeover (every 2 months) or preferably every month. These checks include visual inspection of the sampler, a check of the main screen to ensure that there are no error/status messages, that the current time/date, sampling mode, the default flow rate of 16.7L/min are displayed correctly. In addition, data logger verification is recommended to ensure its current concentration value is within 2 $\mu g/m^3$ of the concentration displayed by the BAM 1020 LCD.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (once per year) or sooner as needed

DESCRIPTION:
External performance check (audit) and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An audit of the flow (single point) is to be carried out by the operator at least every quarter, i.e., on a seasonal basis (the BAM operation manual recommends a monthly inlet flow check). A complete calibration of the ambient temperature, pressure and flow (single-point) must be done at least once per year in accordance with the procedures described in the INSTRUMENT OPERATING MANUAL (the BAM operation manual recommends a semi-annual interval). The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit of the ambient temperature, barometric pressure and flow (all single point) will be performed by the ministry at least twice per year.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

PQ100 Air Sampler (PM_{10})

BGI Incorporated

POLLUTANT	Inhalable Particulate Matter (PM_{10})
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf RFPS-1298-124 (Dec. 1998)
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/files/cfr/recent/pm25des pdf http://www.epa.gov/epahome/cfr40.htm 40 CFR 40 Part 53 40 CFR Part 50, Appendix J & L Operating Manual, Oct. 2003, version 6.21

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL and with the requirements and sample collection filters specified in 40 CFR Part 50 Appendix J. Sampler to operate every 6th day on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Samples to be collected over a 24 hour period from midnight to midnight (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

- Particulate Teflon filters, 47 mm diameter, 2.0 μm pore size
- Reusable filter cassettes
- Certified flow calibration device (e.g., Delta Cal or TriCal)

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	At each filter changeover (every 6th day if on a 6 day schedule)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed manually at each filter changeover. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Internal performance checks include visual inspection of the sampler, a check of the main idle display screen to ensure that: there are no error messages; the current time/date, sample start and stop times/dates, the selected target flow rate of 16.7 L/min and the correct 24-hour sample volume of 24 m^3 for the previous run are correct.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (once per year) or sooner as needed

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An audit of the flow (single point) is to be carried out by the operator quarterly. A calibration of the flow (three-point) must be done at least once per year in accordance with the procedures described in the INSTRUMENT OPERATING MANUAL. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit of the flow (single point), will be performed by the ministry at least twice per year and could include collocated sampling.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

PQ200 Air Sampler (PM_{10})

BGI Incorporated

POLLUTANT	Inhalable Particulate Matter (PM_{10})
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf RFPS-1298-125 (Dec. 1998
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/files/cfr/recent/pm25des pdf http://www.epa.gov/epahome/cfr40.htm 40 CFR Part 53 40 CFR Part 50, Appendix J,L and M Operating Manual, July 2002, Rev. 1.77

OPERATION, SERVICE AND MAINTENANCE
Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL and with the requirements and sample collection filters specified in 40 CFR Part 50 Appendix J, L and M. Sampler to operate every 6th day on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Samples to be collected over a 24 hour period from midnight to midnight (EST). Note: When configured as a PM_{10} sampler, the WINS impactor of the PQ200 is replaced by a straight passage.

ADDITIONAL EQUIPMENT REQUIRED
•Particulate Teflon filters, 47 mm diameter, 2.0 µm pore size • Reusable filter cassettes and single-filter tray; impermeable membrane for internal leak check • Certified flow calibration device (e.g., Delta Cal or TriCal), certified temperature and pressure calibrators

INSTRUMENTATION QA/QC REQUIREMENT	
INTERNAL PERFORMANCE CHECK	At each filter changeover (every 6th day if on a 6 day schedule)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler by the operator. Internal checks are to be performed manually at each filter changeover. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Internal performance checks are to be performed at every filter changeover. These checks include visual inspection of the sampler, a check of the main screen to ensure that: there are no error/status messages, the current time/date, sample start and stop times/dates, the default flow rate of 16.7 L/min and the correct 24-hour sample volume of 24 m^3 for the previous run are correct. In addition, an external leak check and an internal leak check are to be performed monthly.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (once per year) or sooner as needed

DESCRIPTION:
External performance check (audit) and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An audit of the ambient & filter temperature, ambient pressure and flow (single point) is to be carried out by the operator every quarter. A calibration of the ambient & filter temperature, ambient pressure and flow (three-point) must be done at least once per year in accordance with the procedures described in the INSTRUMENT OPERATING MANUAL. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit of the ambient & filter temperature, ambient pressure and flow (single point) will be performed by the ministry at least twice per year.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

Tapered Element Oscillating Micro-Balance (TEOM)

Series 1400, 1400a and 1400ab (PM_{10})

Thermo Electron Corporation
(Formerly Rupprecht & Patashnick Co., Inc.)

POLLUTANT	Inhalable Particulate Matter (PM_{10})
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods –most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf EQPM-1090-079 (Oct. 1990),
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/files/cfr/recent/pm10des.pdf http://www.epa.gov/epahome/cfr40.htm 40 CFR Part 53 40 CFR Part 50, Appendix L Operating Manual, R & P part no. 42-003347 Recommended Operating Procedures for the TEOM, Environment Canada, Report No. AAQD98-4, March 1999.

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should be in accordance with the instrument manufacturer's operation manual and with the applicable requirements specified in 40 CFR Parts 50 and 53. The TEOM is to be operated at a temperature of 30° C (case, air and cap temperature) to minimize the volatilization of semi-volatile particulates and in standard time (EST or CST as determined by local usage). The particulate concentration range is 0-200 $\mu g/m^3$ (in the analog range).

Note: The TEOM may also be operated with a $PM_{2.5}$ sample inlet but has yet to be designated as an automated equivalent method by the USEPA for monitoring $PM_{2.5}$. The series 1400ab has also not been designated.

ADDITIONAL EQUIPMENT REQUIRED

- Teflon-coated glass fiber filter cartridges
- Calibrated multimeter (3½ digit)
- Mass transducer calibration verification kit
- Certified flow (e.g., BIOS, BX-307 or TriCal), temperature and ambient pressure calibration devices.

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	Daily (telemetered status indicators), at each filter replacement

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler by the operator. Internal checks are to be performed manually as described below. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Available status watch indicators will be monitored daily with a telemetered data acquisition system. Corrective action is required when the instrument reports a status or alarm condition. This is required to assess on-going instrument performance such as proper flow rates and filter cartridge loading. A leak check should be performed at each filter change. The air sample inlet should also be cleaned at that time (this frequency can be relaxed to every 6 months depending on the particulate concentration profile at the site). Every 6 months, the large bypass in-line filters should be replaced and the air inlet system should be cleaned. The flow controller filters should be replaced annually.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (once per year) or sooner as needed

DESCRIPTION:
External performance check (audit) and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit (flow, temperature, barometric pressure.)

REQUIREMENT:
An audit of the flows (3.0 L/min for the main flow and 16.7 L/min for the main flow plus auxiliary flow), and a leak check, are to be carried out by the operator at least every quarter, i.e., on a seasonal basis. A complete calibration of the ambient temperature, pressure (depending on the sampler configuration) and flow (single-point) must be done at least once per year in accordance with the procedures described in the INSTRUMENT OPERATING MANUAL The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Annual

DESCRIPTION:
An audit of the ambient temperature, ambient pressure, flow (single point), microbalance "K" value and a leak check will be performed by the ministry at least annually.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

Partisol – FRM Model 2000 PM-2.5 Air Sampler ($PM_{2.5}$)

Thermo Electron Corporation

Formerly Rupprecht & Patashnick Co. Inc.

POLLUTANT	Respirable Particulate Matter ($PM_{2.5}$)
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf RFPS-0498-117 (April 1998), and EQPM-0202-143 (Dec 2006),
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/files/cfr/recent/pm25de.pdf http://www.epa.gov/epahome/cfr40.htm 40 CFR Part 53 40 CFR Part 50, Appendix L Operating Manual, April 2002, Rev. B

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL and with the requirements and sample collection filters specified in 40 CFR Part 50 Appendix L. Sampler to operate every 6th day on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Samples to be collected over a 24 hour period from midnight to midnight (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

- Particulate Teflon filters, 47 mm diameter, 2.0 μm pore size
- Reusable filter cassettes and single-filter tray; leak check disk
- Certified flow calibration device (e.g., Streamline Flow Transfer Standard or TriCal), certified temperature and pressure calibrators

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	At each filter changeover (every 6th day if on a 6 day schedule)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler by the operator. Internal checks are to be performed manually at each filter changeover. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Internal performance checks are to be performed at every filter changeover. These checks include visual inspection of the sampler, a check of the main display screen to ensure that: there are no status codes, the current time/date, sample start and stop times/dates, the default flow rate of 16.7 L/min and the correct 24-hour sample volume of 24 m^3 for the previous run are correct. In addition, an external leak check and an internal leak check are to be performed monthly.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (once per year) or sooner as needed

DESCRIPTION:
External performance check (audit) and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An audit of the ambient & filter temperature, ambient pressure and flow (single point) is to be carried out by the operator every quarter. A calibration of the ambient & filter temperature, ambient pressure and flow (five-point) must be done at least once per year in accordance with the procedures described in the INSTRUMENT OPERATING MANUAL. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit of the ambient & filter temperature, ambient pressure and flow (single point) will be performed by the ministry at least twice per year. The audit could also include collocated sampling.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

PQ200 Air Sampler ($PM_{2.5}$)

BGI Incorporated

POLLUTANT	Respirable Particulate Matter ($PM_{2.5}$)
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf RFPS-0498-116 (April 1998), and EQPM-0202-142 (Dec 2006),
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/files/cfr/recent/pm25de.pdf http://www.epa.gov/epahome/cfr40.htm 40 CFR 40 Part 53 40 CFR Part 50, Appendix L Operating Manual, July 2002, Rev. 1.77

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL and with the requirements and sample collection filters specified in 40 CFR Part 50 Appendix L. Sampler to operate every 6th day on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Samples to be collected over a 24 hour period from midnight to midnight (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

- Particulate Teflon filters, 47 mm diameter, 2.0 μm pore size
- Reusable filter cassettes and single-filter tray; impermeable membrane for internal leak check
- Certified flow calibration device (e.g., Delta Cal or TriCal), certified temperature and pressure calibrators

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	At each filter changeover (every 6th day if on a 6 day schedule)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler by the operator. Internal checks are to be performed manually at each filter changeover. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Internal performance checks are to be performed at every filter changeover. These checks include visual inspection of the sampler, a check of the main screen to ensure that: there are no error/status messages, the current time/date, sample start and stop times/dates, the default flow rate of 16.7L/min and the correct 24-hour sample volume of 24 m^3 for the previous run are correct. In addition, an external leak check and an internal leak check are to be performed monthly.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (once per year) or sooner as needed

DESCRIPTION:
External performance check (audit) and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An audit of the ambient & filter temperature, ambient pressure and flow (single point) is to be carried out by the operator every quarter. A calibration of the ambient & filter temperature, ambient pressure and flow (three-point) must be done at least once per year in accordance with the procedures described in the INSTRUMENT OPERATING MANUAL. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit of the ambient & filter temperature, ambient pressure and flow (single point) will be performed by the ministry at least twice per year. The audit could also include collocated sampling.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

PQ200-VSCC or PQ200A-VSCC Air Sampler ($PM_{2.5}$)

BGI Incorporated

POLLUTANT	Respirable Particulate Matter ($PM_{2.5}$)
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	List of designated reference and equivalent methods – most recent version: http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf EQPM-0202-142 (Feb. 2002)
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/files/cfr/recent/pm25de.pdf http://www.epa.gov/epahome/cfr40.htm 40 CFR Part 53 40 CFR Part 50, Appendix L Operating Manual, July 2002, Rev. 1.77 Very Sharp Cut Cyclone(VSCC) Supplemental Manual (Appendix M).

OPERATION, SERVICE AND MAINTENANCE
Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL and with the requirements and sample collection filters specified in 40 CFR Part 50 Appendix J, L and M. Sampler to operate every 6th day on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Samples to be collected over a 24 hour period from midnight to midnight in standard time (EST or CST as determined by local usage). Note: The PQ200A-VSCC is a portable audit sampler.

ADDITIONAL EQUIPMENT REQUIRED
•Particulate Teflon filters, 47 mm diameter, 2.0 µm pore size •Reusable filter cassettes and single-filter tray; impermeable membrane for internal leak check •Certified flow calibration device (e.g., Delta Cal or TriCal), certified temperature and pressure calibrators •Transport cases for the PQ200A

INSTRUMENTATION QA/QC REQUIREMENT	
INTERNAL PERFORMANCE CHECK	At each filter changeover (every 6th day if on a 6 day schedule)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler by the operator. Internal checks are to be performed manually at each filter changeover. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Internal performance checks are to be performed at every filter changeover. These checks include visual inspection of the sampler, a check of the main screen to ensure that: there are no error/status messages, the current time/date, sample start and stop times/dates, the default flow rate of 16.7 L/min and the correct 24-hour sample volume of 24 m^3 for the previous run are correct. In addition, an external leak check and an internal leak check are to be performed monthly.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (once per year) or sooner as needed

DESCRIPTION:
External performance check (audit) and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An audit of the ambient & filter temperature, ambient pressure and flow (single point) is to be carried out by the operator every quarter. A calibration of the ambient & filter temperature, ambient pressure and flow (three-point) must be done at least once per year in accordance with the procedures described in the INSTRUMENT OPERATING MANUAL. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit of the ambient & filter temperature, ambient pressure and flow (single point) will be performed by the ministry at least twice per year and could include collocated sampling.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

AEROCET 7350 Aerosol Monitor (PM_1 TO TSP)

Met One Instruments, Inc.

POLLUTANT	Particulate Matter Aerosols (PM_1 to TSP)
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated by USEPA as a reference or equivalent method.
REFERENCE DOCUMENTS	Operating Manual, AEROCET-7350-9800 Rev B.

OPERATION, SERVICE AND MAINTENANCE

The AeroCet 7350 operates in the mass mode (measurements in $\mu g/m^3$ for PM_1, $PM_{2.5}$, PM_5, PM_7, PM_{10} and TSP), and in the particle count mode (counts/liter for the following ranges: >0.3, >1.0, >2.5, >5, >7 and >10 µm). Operation, service and maintenance of the monitor should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL. The monitor can be programmed for continuous operation and for timed operation (e.g. 24 hours). The monitoring schedule will depend on the data collection requirements and must be approved by the ministry prior to start-up of the monitoring program. The monitor is to be operated on EST or CST (as determined by local usage) time.

ADDITIONAL EQUIPMENT REQUIRED

•Particulate filters, 47 mm diameter, 2.0 µm pore size (typically PTFE Teflon or quartz depending upon subsequent lab analysis)
•Reusable 47 mm filter cartridges
•Certified flow (e.g., BIOS Brand or TriCal), temperature and barometric pressure calibration devices

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	Monthly for normal particulate levels and considerably shorter for sampling in highly contaminated areas (e.g. forest fires)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed monthly or more often if the monitor is used in areas with elevated particulate levels. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
These checks include visual inspection of the sampler for particle contamination, a check of the main display screens to ensure that: there are no error messages (alarm log); the current time/date, sampling schedule and the selected target flow rate are correct. A leak check is also to be included on a monthly basis.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (once per year) or sooner as needed

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An audit of the flow (three points) is to be carried out by the operator at least quarterly (the manufacturer's operation manual recommends monthly). A factory calibration of the flow must be done every two years. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit of the flow (single point), will be performed by the ministry at least twice per year.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

GRIMM Model 107 Ambient Dust Monitor (PM_1, $PM_{2.5}$, TSP_{10})

GRIMM Aerosol Technik GmbH & Co., KG

POLLUTANT	**Particulate Matter (PM_1, $PM_{2.5}$ and PM_{10})**
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated by USEPA as a reference or equivalent method.
REFERENCE DOCUMENTS	Operating Manual, ENVIROcheck Environmental Dust Monitoring, May 2002

OPERATION, SERVICE AND MAINTENANCE

The GRIMM model 107 ambient dust monitor is a portable (or stationary) unit which simultaneously measures PM_1, $PM_{2.5}$ and PM_{10} concentrations in $\mu g/m^3$ and particle counts (particles/liter) for particle sizes ranging from 0.25 to 32 µm. The mass concentration measurement range is 0.1 to 1500 $\mu g/m^3$. Operation, service and maintenance of the monitor should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL. The monitor can be programmed for continuous operation and for timed operation (e.g., 1 to 60 minute intervals between measurement sets). The monitoring schedule will depend on the data collection requirements and must be approved by the ministry prior to start-up of the monitoring program. The monitor is to be operated on EST or CST (as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

•Particulate filters, 47 mm diameter, 2.0 µm pore size (typically PTFE Teflon) depending upon subsequent lab analysis)
•Silica gel cartridges, computer cleaning tissue, compressed air

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	Monthly to every 3-6 months for normal particulate levels and considerably shorter for sampling in highly contaminated areas (e.g. forest fires, industrial sites)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed monthly to every 3-6 months, or more often if the monitor is used in areas with elevated particulate levels. These checks are required to assess routine instrument performance and to ensure adherence to ministry QA/QC and reporting practices.

REQUIREMENT:
Monthly checks include visual inspection of the sampler for particle contamination, a visual check of the silica gel cartridge (for colour change) when the sampler is used in the weather housing, a check of the main display screens to ensure that: there are no error messages (alarm log); the current time/date, sampling schedule and the selected target flow rate are correct. Semi-annual maintenance includes cleaning the ventilation system of the weather housing (changing the inlet filter) and cleaning the ambient air inlet port. The 47 mm PTFE filter, used to check the C-factor of the monitor, should be changed when the theoretical particulate mass on the filter reaches 20 mg (about every 3 months for normal environmental monitoring activity) or more often in high dust locations.

EXTERNAL PERFORMANCE CHECK (AUDIT) AND CALIBRATION	Audits (quarterly), calibration (every 18 to 24 months) or sooner as needed

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out with a certified calibration unit.

REQUIREMENT:
The sampler is required to be factory calibrated by the manufacturer, or by an authorized firm capable of providing this service, every 18 to 24 months. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices.

AUDIT	Annual

DESCRIPTION:
An audit (collocated sampling) of the sampling system will be performed by the ministry at least twice per year.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported in writing to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices. A follow-up audit may be performed by the ministry as a result of an audit failure.

Total Dustfall

POLLUTANT	Total Dustfall
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated by USEPA
REFERENCE DOCUMENTS	ASTM Method D 1739-98, 1998. Standard Method for the Collection and Analysis of Settleable Particulate, ASTM Part 26, p. 340 The Determination of Total Dustfall in Air Emissions by Gravimetry, Ministry of the Environment Laboratory Services Branch, Quality Management Office, Method Catalogue Code DF-E3043A, September 8, 1995
METHOD	Standard Plastic Dustfall Jars with 4 mil Polyethylene Liners and Exposed Without the Addition of Water or Ethylene Glycol

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the sampler should be in accordance with the instructions in the documents referenced above, and the ministry's *Operations Manual for Air Quality Monitoring in Ontario*, unless otherwise stated. Sampler should be set out for 30 day periods, preferably within a few days of the beginning of a month, unless an alternate schedule is warranted and has been approved by the ministry. Rainwater/snow collected in the jar must be kept in the plastic liner and submitted to the lab as part of the sample

ADDITIONAL EQUIPMENT REQUIRED

•Appropriate collar bracket and jar picker to minimize/eliminate use of ladders
•Suitable rugged containers for shipment of samples to the lab

QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	At sample changeovers (every 30 days)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out with the sampler. Internal checks are to be performed at each sample changeover and are required to assess routine sampler performance.

REQUIREMENT:
Sample changeover should be as close as possible to the beginning of a month. The exposure period should be 30 days (± 5 days). These checks include: visual inspection of the sampler to ensure the integrity of the plastic jar and polyethylene liner, a visual inspection of the sample to determine the possible presence of interfering materials (e.g., significant algae growth) which could invalidate the sample, confirmation of the 'on' and 'off' sample collection dates and the correct exposure month.

EXTERNAL PERFORMANCE CHECK	Twice per year

DESCRIPTION:
For this type of sampling activity, an external performance check is defined as a QA/QC procedure carried out by the operator to ensure that the site is continuing to meet the overall monitoring objectives.

REQUIREMENT:
An external performance check is to be carried out by the operator at least twice per year and/or when the internal performance check shows that the site may no longer be suitable for meeting overall monitoring program objectives. This includes non compliance with siting criteria, unacceptable sampling interferences from nearby air emission sources due to new point sources and/or nearby land use changes. The results of the external performance check must be recorded and the documentation must be available for inspection and/or submission to the ministry.

AUDIT	Once per year

DESCRIPTION:
An audit will be performed by the ministry at least once per year.

REQUIREMENT:
Corrective action (e.g., sampler repairs, sampler relocation, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Fluoridation Rate

POLLUTANT	Hydrogen Fluoride
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated by USEPA
REFERENCE DOCUMENTS	ASTM Method D 3269-96 (2001) e1. Standard Test Method for Analysis for Fluoride Content of the Atmosphere and Plant Tissues
Ministry RECOMMENDED METHOD	Lime candle

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the sampler should be in accordance with the instructions in the document referenced above and in the ministry's *Operations Manual for Air Quality Monitoring in Ontario*, unless otherwise mentioned. Sampler should be set out for 30 day periods, preferably within a few days of the beginning of a month, unless an alternate schedule is warranted and has been approved by the ministry.

ADDITIONAL EQUIPMENT REQUIRED

•Suitable containers (with proper seals) for shipment of samples to/from the lab
•Suitable louvered shelter to house the lime candle

QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	At each sample changeover (every 30days)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out with the sampler. Internal checks are to be performed at each sample changeover and are required to assess routine sampler performance.

REQUIREMENT:
Internal performance checks are to be performed at every sample changeover which is to be as close as possible to the beginning of a month. The exposure period should be 30 days (± 5 days). These checks include: visual inspection of the container used to ship the candle from the lab to ensure it has not been opened prior to candle being exposed in the field; visual inspection of the candle to ensure its integrity; inspection of the shelter for signs of vandalism/tampering to ensure candle was not directly exposed to the elements; check for good air flow through the louvers (no obstructions); confirmation of the 'on' and 'off' sample collection dates to meet the exposure period requirement and the correct exposure month.

EXTERNAL PERFORMANCE CHECK	Twice per year

DESCRIPTION:
For this type of sampling activity, an external performance check is defined as a QA/QC procedure carried out by the operator to ensure that the site is continuing to meet the overall monitoring objectives.

REQUIREMENT:
An external performance check is to be carried out by the operator at least twice per year and/or when the internal performance check shows that the site may no longer be suitable for meeting overall monitoring program objectives. This includes non compliance with siting criteria, unacceptable sampling interferences from nearby air emission sources due to new point sources and/or nearby land use changes. The results of the external performance check must be recorded and the documentation must be available for inspection and/or submission to the ministry.

AUDIT	Once per year

DESCRIPTION:
An audit will be performed by the ministry at least once per year and could include collocated sampling.

REQUIREMENT:
Corrective action (e.g., sampler repairs, sampler relocation, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Volatile Organic Compounds – Absorbent Cartridge (VOCs)

POLLUTANT	Volatile Organic Compounds (VOCs)
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/airtox.html USEPA Report EPA/625/R-96/010b, USEPA Method TO-17 ASTM Method D6196-97, Vol. 11.03 Ministry of the Environment Laboratory Services Branch Method E3314, June 28, 2002
MINISTRY OF THE ENVIRONMENT RECOMMENDED METHOD	Determination of VOCs in Ambient Air Using Three-Phase Adsorbent Cartridges Followed by Thermal Desorption and GC-MS analysis

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the sampler should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned. Data to be collected in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

•Solid Sorbent Tube (glass or stainless steel) 6 mm O.D. packed with greater than 200 mg of solid adsorbent material (Supelco Carbotrap 300)
•Flow controller capable of maintaining a flow of 2.5 cm^3/min. (± 0.25 cm^3/min) over 24 hours
•Ice cooler to hold exposed cartridges between 2°C and 10°C during shipment to lab
•Certified flow calibration device

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	every 12 days (or alternate schedule) during sample changeover

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed manually during sample collection. These checks are required to assess instrument performance such as proper flow controller operation and confirmation of the correct time, date and sampling date on the flow controller/timer to ensure adherence to ministry QA/QC requirements and reporting practices.

REQUIREMENT:
Internal performance checks are to be performed during every sample changeover. These checks include visual observation of the sampler, a check of the flow controller to ensure the correct time and date and a check of the voltage output (if applicable) to ensure that the proper flow rate of 2.5 cm^3/min (± 0.25 cm^3/min) is being maintained.

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Quarterly

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An external performance check and calibration is to be carried out by the operator quarterly and before (e.g., flow deviation of ± 5% or more of 2.5 cm^3/min) the internal performance check shows that the flow is greater than ±10% of the required flow (2.5 cm^3/min). The calibration must be done in accordance with the procedures described in the USEPA reference documents. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit will be performed by the ministry at least twice per year. And could include collocated sampling.

REQUIREMENT:
Corrective action (e.g., sampler repairs, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Volatile Organic Compounds – Evacuated Canister (VOCs)

POLLUTANT	Volatile Organic Compounds (VOCs)
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/airtox.html USEPA Report EPA/625/R-96/010b, USEPA Method TO-15 ASTM Method D5466-01 Standard Test Method for the Determination of VOCs (Canister Sampling Method) Environment Canada SOP for Passive Canister Sampling – Passive FCSOP05
SAMPLING METHOD	Determination of VOCs in Air Collected in Specially-Prepared Canisters and Analyzed by GC-MS

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the sampler should be in accordance with the INSTRUMENT MANUFACTURE'R OPERATING MANUAL unless otherwise mentioned. Data to be collected in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

•Flow controller capable of maintaining a flow of 3.5 mL/min. over 24 hours
•Stainless steel vacuum gauge capable of measuring 0.05 mm Hg
•Crescent wrench
•Inlet line (stainless steel tubing ¼ ″ ID or 1/8″ ID
•Sintered stainless steel in-line filter (2 micron pore size)

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	every 12 days during sample collection

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed manually during sample collection. These checks are required to assess sampler performance such as proper flow controller operation to ensure adherence to ministry QA/QC requirements and reporting practices

REQUIREMENT:
The checks include visual observation of the sampler to ensure that it is not damaged (valve opens/closes properly), vacuum gauge is functional and flow controller is properly installed on top of the canister valve. Sampling system must be leak free. Initial vacuum should be about -29 inches of Hg and the final vacuum should be between -5 to -10 inches of Hg.

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Twice per year

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out with a certified calibration unit.

REQUIREMENT:
An external performance check and calibration of the vacuum gauge and flow controller is to be carried out twice per year. The calibration must be done in accordance with the procedures described in the USEPA reference documents. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit will be performed by the ministry at least twice per year and could include collocated sampling.

REQUIREMENT:
Corrective action (e.g., sampler repairs, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Polycyclic Aromatic Hydrocarbons – Filter (PAHs)

Non-Volatile Fraction

POLLUTANT	Polycyclic Aromatic Hydrocarbons (PAHs) – Three Member Rings & Up
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/airtox.html USEPA Report EPA/625/R-96/010/b, USEPA Method TO-13A ASTM Method D6209-98, Vol. 11.03 Ministry of the Environment Laboratory Services Branch, Method PAHAIR/APSD- E3124 (Oct. 2006) Polycyclic Aromatic Hydrocarbons in Ambient Air - Standard Operating Procedure and Technical Manual, Ministry of the Environment, Air Resources Branch, 1992 A Guide to Air Filter (TSP and PM_{10}) Sampling and Submission, Ministry of the Environment, May 2003.
METHOD	Determination of PAHs in Ambient Air Using the hi-vol Method With Teflon-coated Glass Fiber Filter (without sorbent cartridge) with Subsequent Quantitative GC/MS Detection

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the analyzer should in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned. Sampler to operate every 12th day based on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Air samples (~610 m^3) to be collected over a 24-hour period from midnight to midnight in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

•Flow controller capable of maintaining a flow of about 15 cfm (± 1.5 cfm) over 24 hours
•Teflon-coated glass fibre filter (or quartz filter??) 8" by 10" in size
•Ice chest to hold samples at ≤ 4°C for shipment to the lab after collection
•Aluminum foil to ship exposed filters to the lab
•Certified flow calibration device
Refrigerator to keep exposed filters cool (≤4°C) before analysis

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	every 12 days (or alternate schedule) during sample changeover

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed manually at each filter changeover. These checks are required to assess instrument performance such as proper flow controller operation and confirmation of the correct time, date and sampling date on the flow controller/timer and to ensure adherence to ministry QA/QC requirements and reporting practices.

REQUIREMENT:
These checks include visual inspection of the sampler, a check of the flow controller to ensure that the flow is being maintained (controller slows down the motor rpm to maintain a slower rpm) and confirmation of the correct time of day (EST or CST as determined by local usage), correct sampling day and duration (24 hours).

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Quarterly

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An external performance check and calibration is to be carried out by the operator at least quarterly and before (e.g., flow deviation of ± 5% or more of 15 cfm) the internal performance check shows that the flow is greater than ± 10% of the required flow (15 cfm). The calibration must be done in accordance with the procedures described in the reference documents, specifically the *Ministry of the Environment Guide to Air Filter (TSP and PM_{10}) Sampling and Submission, May 2003.* The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Two Times per year

DESCRIPTION:
An audit will be performed by the ministry at least twice per year. The ministry may also audit the PAH sampling program by performing collocated monitoring.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices

Polycyclic Aromatic Hydrocarbons – Filter & PUF Cartridge (PAHs)

VOLATILE & NON-VOLATILE FRACTIONS

POLLUTANT	Polycyclic Aromatic Hydrocarbons (PAHs) – Three Member Rings & Up
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated as a reference or equivalent method
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/airtox.html USEPA Report EPA/625/R-96/010/b, USEPA Method TO-13A ASTM Method D6209-98 (2004), Vol. 11.07 A Guide to Air Filter (TSP and PM_{10}) Sampling and Submission, Ministry of the Environment, May 2003.
METHOD	Determination of PAHs in Ambient Air Using the hi-vol Method With Teflon-coated Glass Fiber Filter and Sorbent Cartridge; Quantitative GC/MS Detection

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the sampler should be in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned. Sampler top operate every 12th day based on the standard North American schedule, unless an alternate schedule is warranted and has been approved by the ministry. Air samples (>300 m^3) to be collected over a 24-hour period from midnight to midnight in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT REQUIRED

- Modified hi-vol with flow controller capable of maintaining a flow of about 8 cfm (± 0.8 cfm) over 24 hours
- Teflon-coated glass fibre filter (or quartz filter) 8" by 10" in size
- PUF or XAD-2 resin cartridge (see note 1 below)
- PUF absorbent cartridge assembly and shipping container (Al canister)
- Ice chest to hold samples at ≤ 4°C for shipment to the lab after collection
- Aluminum foil to ship exposed filters to the lab
- Certified flow calibration device
- Refrigerator to keep exposed filters in the dark and cool (≤4°C)

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed manually at each filter changeover. These checks are required to assess instrument performance and to ensure adherence to ministry QA/QC requirements and reporting practices.

REQUIREMENT:
Internal performance checks are to be performed during every filter changeover. These checks include: visual observation of the sampler, a check of the flow controller to ensure that the flow is being maintained (controller slows down the motor rpm to maintain a slower rpm) and confirmation of the correct time of day (EST or CST as determined by local usage), correct sampling day and duration (24 hours).

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Every quarter

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An external performance check and calibration is to be carried out by the operator quarterly, or sooner if the internal performance check shows that the flow controller does not appear to be functioning properly or the ΔP is not in the expected range. The calibration must be done in accordance with the procedures described in the reference documents, specifically the *Ministry of the Environment Guide to Air filter (TSP and PM_{10}) Sampling and Submission, May 2003.* The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified annually against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit will be performed by the ministry at least twice per year. The ministry may also audit the PAH sampling program by performing collocated monitoring.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Dioxins and Furans (PCDD/PCDF)

POLLUTANT	Dioxins and Furans
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated
REFERENCE DOCUMENTS	http://www.epa.gov/ttn/amtic/airtox.html USEPA Report EPA/625/R-96/010b, USEPA Method TO-9A, Jan 1999 Environment Canada Method 1/RM/19 and CEN-EN 1948 for PCDD/PCDFs Ministry of the Environment, Laboratory Services Branch, Method E3418, Jan. 2003
METHOD	Determination of DIOXINS AND FURANS in Air Using Teflon-coated Glass Fibre Filter and Polyurethane (PUF) Plug, Followed by Soxhlet Extraction with Toluene and GC/MS
OPERATION, SERVICE AND MAINTENANCE	
Operation, service and maintenance of the analyzer should be in accordance with the INSTRUMENT MANUFACTURE'S OPERATING MANUAL unless otherwise mentioned. Data to be collected in standard time (EST or CST as determined by local usage).	
ADDITIONAL EQUIPMENT REQUIRED	
•Polyurethane Foam (PUF) Plug of solid adsorbent material. •Flow controller capable of maintaining a flow of 8 cfm (± 0.8 cfm) over 24 hours. •Dry gas meter to monitor total volume of ambient air sampled. •Ice cooler to hold samples at 4°C or cooler during shipment to laboratory •Teflon-coated glass fibre filter 8" by 10" in size •Certified flow calibration device •Aluminum foil to wrap exposed filter for shipment to lab	
INSTRUMENTATION QA/QC REQUIREMENT	
INTERNAL AUDIT CHECK	every 12 days (or alternate schedule) during sample changeover

DESCRIPTION:
Internal performance check is defined as a QA/QC procedure carried out within the sampler. Internal checks are to be performed manually at each sample changeover. These checks are required to assess instrument performance such as proper flow controller operation and confirmation of the correct time, date and sampling date on the flow controller/timer and to ensure adherence to ministry QA/QC requirements and reporting practices.

REQUIREMENT:
These checks include visual inspection of the sampler, a check of the flow controller to ensure that the flow is being maintained (controller slows down the motor rpm to maintain a slower rpm) and confirmation of the correct time of day (EST or CST as determined by local usage), correct sampling day and duration (24 hours).

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Quarterly

DESCRIPTION:
External performance check and calibration is defined as a QA/QC procedure carried out by the operator with a certified calibration unit.

REQUIREMENT:
An external performance check and calibration is to be carried out by the operator at least quarterly and before (e.g., flow deviation of ± 5% or more of 8 cfm) the internal performance check shows that the flow is greater than ± 10% of the required flow (8 cfm). The calibration must be done in accordance with the 8procedures described in the USEPA reference documents. The results of the external performance check and calibration must be recorded and the documentation must be available for inspection and/or submission to ministry to ensure adherence to ministry QA/QC and reporting practices. The calibration equipment must be certified against a reference or transfer standard traceable to recognized national primary standards.

AUDIT	Twice per year

DESCRIPTION:
An audit will be performed by the ministry at least twice per year. The ministry may also audit the PAH sampling program by performing collocated monitoring.

REQUIREMENT:
Corrective action (e.g., sampler repairs/cleaning, flow adjustment, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported as soon as practical to the ministry to ensure adherence to ministry QA/QC and reporting practices.

Wind Speed and Direction

POLLUTANT	Wind Speed and Direction
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated
REFERENCE DOCUMENTS	http://www.epa.gov/scram001/guidance/met/mmgrma.pdf USEPA report EPA-454/R-99-005
METHOD	Determination of wind speed by (cup or propeller) anemometer and wind direction by bi-directional wind vanes. Units with no moving parts (ultrasonic, solid state methods) have not been commonly used for routine monitoring but can be considered after a proper evaluation.

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the anemometer and wind vanes should in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned

ADDITIONAL EQUIPMENT

•Recommend a spare anemometer as a preventative maintenance measure

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	Daily

DESCRIPTION:
In this application, an internal performance check is defined as a QA/QC procedure carried out by inspecting the wind speed and direction data once per day. These checks are required to remotely assess, in a qualitative sense, performance of the wind speed and direction data measurement and collection system and to ensure adherence to ministry QA/QC requirements and reporting practices

REQUIREMENT:
Wind speed and direction data are to be inspected daily to check for extreme values (e.g., unusually high/low wind speeds, constant wind directions for sustained periods, etc.), or for values which do not appear to agree with forecasted or observed wind conditions. The results of these data checks could suggest anemometer/wind vane failure (damaged anemometer, worn out bearings, missing cups, frozen wind vane, etc.). Some specific data screening criteria are presented in Table 8-4 of the USEPA report EPA-454/R-99-005. The results of these checks which could suggest system/equipment problems should be acted on as required and documented for data validation purposes.

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Monthly (first level inspection) and at least once a year (second level inspection)

DESCRIPTION:
In this application, an external performance check and calibration is defined as a QA/QC procedure carried out by the operator, such as physical inspections of the equipment (monthly), or calibration checks (once per year or as recommended by the manufacturer, whichever comes first). It is highly recommended to change the anemometer every year to prevent failure due to bearing ware.

REQUIREMENT:
The first level of inspection is visual (anemometer and vane can be looked at directly or through binoculars/telescope to check for physical damage or signs of erratic behavior). The second level of inspection is a "hands on" check which requires removal of the anemometer/wind vane from the tower/mast for further testing/calibration (e.g., bearings replacement, calibration test). Conservatively, operators should not wait for failures and as part of a preventative maintenance program and it is recommended that they have a spare unit on hand and consider replacing/refurbishing the active unit annually. The calibration equipment must be certified against a reference or equivalent standard, and traceable to recognized national primary standards.
The results of the external performance check/calibration must be recorded and the documentation available for inspection and/or submission to ministry to ensure adherence to ministry QA/QC and reporting practices.

AUDIT	Annually or bi-annually

DESCRIPTION:
An audit will be performed by the ministry every one to two years.

REQUIREMENT:
Corrective action (e.g., anemometer and/or wind vane repairs/ replacement, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Ambient Temperature

POLLUTANT	Ambient Temperature
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated
REFERENCE DOCUMENTS	http://www.epa.gov/scram001/guidance/met/mmgrma.pdf USEPA report EPA-454/R-99-005
METHOD	Resistance change thermometer sensor such as a platinum or copper resistance temperature detector (RTD), housed in a motor aspirated solar radiation shield.

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the anemometer and wind vanes should in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned. Data to be collected in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT

•Airflow warning device in solar radiation shield
•Calibrated DVM with proper input impedance
•Reference temperature sensor accurate to about ≤1°C

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	Daily

DESCRIPTION:
In this application, an internal performance check is defined as a QA/QC procedure carried out by inspecting the temperature data once per day. These checks are required to remotely assess, in a qualitative sense, performance of the ambient temperature data measurement and collection system and to ensure adherence to ministry QA/QC requirements and reporting practices.

REQUIREMENT:
Ambient temperature data are to be inspected daily to check for extreme values (e.g., unusually high/low values, constant temperature readings for sustained periods, sudden and unexpected temperature changes over a short time period, etc.), or for values which do not appear to agree with forecasted or observed temperature conditions. The results of these data checks could suggest equipment failure (faulty temperature sensor, failure of airflow aspiration system, etc.). Some specific data screening criteria are presented in Table 8-4 of the USEPA report EPA-454/R-99-005. The results of these checks which could suggest system/equipment problems should be acted on as required and documented for data validation purposes.

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Monthly (first level inspection) and at least once a year (second level inspection)

DESCRIPTION:
In this application, an external performance check and calibration is defined as a QA/QC procedure carried out by the operator, such as physical inspections of the equipment (monthly), or calibration checks (once per year or as recommended by the manufacturer, whichever comes first).

REQUIREMENT:
The first level of inspection is visual (solar radiation shield can be looked at directly or through binoculars/telescope to check for physical damage or cleanliness – no air flow restrictions, sound of aspiration motor, etc.) The second level of inspection is a "hands on" check which requires removal of the temperature sensor from the tower/mast for further testing/calibration (e.g., replacement/repair of the aspiration motor, calibration testing of the temperature sensor according to the manufacturer's recommended procedures). Conservatively, operators should not wait for failures and as part of a preventative maintenance program it is recommended that they have a spare aspiration motor/fan on hand and replace/refurbish the active unit as recommended by the manufacturer, or at least once every 2 years. The calibration equipment must be certified against a reference or equivalent standard, and traceable to recognized national primary standards.
The results of the external performance check/calibration must be recorded and the documentation available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices.

AUDIT	Annually or bi-annually

DESCRIPTION:
An audit will be performed by the ministry every one to two years.

REQUIREMENT:
Corrective action (e.g., anemometer and/or wind vane repairs/ replacement, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Solar Radiation

POLLUTANT	Ambient Temperature
USEPA DESIGNATED REFERENCE AND EQUIVALENT METHOD	Not designated
REFERENCE DOCUMENTS	http://www.epa.gov/scram001/guidance/met/mmgrma.pdf USEPA report EPA-454/R-99-005
METHOD	Depending on the application, either a net radiometer or a first/second class pyranometers with WMO specifications

OPERATION, SERVICE AND MAINTENANCE

Operation, service and maintenance of the anemometer and wind vanes should in accordance with the INSTRUMENT MANUFACTURER'S OPERATING MANUAL unless otherwise mentioned. Data to be collected in standard time (EST or CST as determined by local usage).

ADDITIONAL EQUIPMENT

•Electrical light bulb (100 watts or similar)
•Calibrated DVM with proper input impedance
•Complete opaque cover (for 0 check)

INSTRUMENTATION QA/QC REQUIREMENT

INTERNAL PERFORMANCE CHECK	Daily

DESCRIPTION:
In this application, an internal performance check is defined as a QA/QC procedure carried out by inspecting the solar radiation data once per day. These checks are required to remotely assess, in a qualitative sense, performance of the radiation data measurement and collection system and to ensure adherence to ministry QA/QC requirements and reporting practices.

REQUIREMENT:
Solar radiation data are to be inspected daily to check for extreme values (e.g., unusually high/low values, constant temperature readings for sustained periods, sudden and unexpected changes over a short time period, radiation readings >0 at night, etc.), or for values which do not appear to agree with the maximum possible value for the date and latitude. The results of these data checks could suggest equipment failure (faulty sensor, electrical signal processing problems, etc.). Some specific data screening criteria are presented in Table 8-4 of the USEPA report EPA-454/R-99-005. The results of these checks which could suggest system/equipment problems should be acted on as required and documented for data validation purposes.

EXTERNAL PERFORMANCE CHECK AND CALIBRATION	Monthly (first level inspection) and at least once a year (second level inspection)

DESCRIPTION:
In this application, an external performance check and calibration is defined as a QA/QC procedure carried out by the operator, such as physical inspections of the equipment (monthly), or calibration checks (once per year or as recommended by the manufacturer, whichever comes first).

REQUIREMENT:
The first level of inspection is visual: solar radiation sensor should be checked for physical damage/integrity (scratches or cracks on surfaces of the hemisphere), for cleanliness (optical hemispheres should be cleaned frequently with a soft lint-free cloth) and for any discoloration/deformation of the detectors. This level of inspection should also include confirmation that the site is maintaining acceptable siting criteria so that the radiation data is not adversely affected by nearby objects or surfaces. The second level of inspection is a "hands on" check which requires removal of the solar radiation sensor from the field for further testing and possible zero adjustment/calibration (e.g., calibration/testing according to the manufacturer's recommended procedures). Conservatively, operators should not wait for failures and as part of a preventative maintenance program it is recommended that they have a spare sensor on hand and replace/refurbish the active unit as recommended by the manufacturer, or at least once every 2 years. The calibration equipment must be certified against a reference or equivalent standard, and traceable to recognized national primary standards.

The results of the external performance check/calibration must be recorded and the documentation available for inspection and/or submission to the ministry to ensure adherence to ministry QA/QC and reporting practices.

AUDIT	Annually or bi-annually

DESCRIPTION:
An audit will be performed by the ministry every one to two years.

REQUIREMENT:
Corrective action (e.g., sensor replacement, data correction, etc.) will be required by the operator if the audit results show non conformance with acceptable operation, service and maintenance requirements. The corrective action must be recorded and reported to the ministry as soon as practical to ensure adherence to ministry QA/QC and reporting practices.

Appendices

Appendix 1: Sample Pollutant Log

Pollutant Log

Pollutant	Page No.

Station No.	Location	Month	Year

Instrument Make	Instrument Serial No.	Range ppb

Date								
Time								
Initials								
Logger Zero Response (ppb)								
Zero Response (Volts)								
Logger Zero Reset (ppb)								
Internal Source/Span Value (ppb)								
Logger Span Response (ppb)								
Span Response (Volts)								
Logger Span Reset (ppb)								
Zero Pot Setting // BKG (ppb)								
Span Pot setting // COEF								
Sample Flow (L/min)								
Pressure (mm Hg)								
Lamp Voltage (Volts)								
Lamp Intensity (Hz)								
PMT (Volts)								
Mode T1 REF% // Internal (°C)								
Mode T2 HV% // Chamber (°C)								
Mode T3 CHOP% // Perm. Gas (°C)								
Inlet Filter Replaced								

Repairs / Audits / Comments

Appendix 2: List of Activities to be performed during Station Visits

One of the main purposes of monitoring station visits is to verify the proper operation of the monitoring equipment and of data acquisition systems to ensure the collection of valid and complete data. A second important purpose is to verify the continued safe and secure environment at the station. Diagnostic tests, which can be performed remotely on various monitoring equipment and station parameters, complement the station visit verification.

Station visits should be documented in the site logbook. The following is a list of recommended activities to be performed at the station:

- Examine the external station conditions including the inlet probe for damage or blockage. Periodically review the station characteristics for any change or modification to the station to ensure that siting criteria continue to be met.

- Examine the manifold, if applicable, the transfer lines (or inlet line) and the inlet filters for dirt build-up and replace the filter or clean the lines as required. Examine the seals in the sampling system, the scrubbing and drying agents, and replace as required.

- Perform zero and span verifications on the analyzers at least monthly. Record the values and note abnormal deviations. All adjustments need to be documented.

- Perform preventative maintenance as prescribed in the instrumentation operations and maintenance manuals.

- Check the heating/cooling system to ensure that the station temperature is maintained in the required temperature range.

- Ensure that the analyzers are in the sample mode before exiting the shelter.

- Ensure that the shelter door and gate (if applicable) are locked upon leaving the station.

Appendix 3: Guidance for Electronically Submitting Validated Data

The ministry requires electronic submission of raw and edited emitter data on a quarterly basis. This data will then be uploaded into a database. Prior to the first submission of data, the ministry requires that Table 7 be submitted along with a sample of the data to confirm the format in which the data will be received so that the ministry can initialize and test the industry station in the database.

The first column will always contain the date and the second column time. It is important that the format be identical each quarter. Data is to be submitted as a time series, not as a monthly matrix. Acceptable data formats include Excel, CSV (comma separated values), or Enview. Each quarter the submission must include a separate file for each month and the files must contain data ordered from oldest to newest, e.g., Jan 01/07 0:00 to Jan 31/07 23:00. Examples of acceptable formats are provided in Figures 1 and 2.

If the emitter makes any changes (including service pack installation and upgrades) to their systems after the initial acceptance of their data format by the ministry, the emitter should verify that the formats have not changed. If the data is no longer importable into the ministry's database, the ministry will provide guidance about the problems and the emitter may be asked to resubmit the data.

Table 7: Station Registration Template

Industry Name					
Station Number					
Station Name					
Station Address/Location					
Operator Contact (Name, Phone, Email)					
Industry Contact (Name, Phone, Email)					
Time Resolution (e.g., 5 min, 0.5 hr, 1 hr)					
Start date and time of dataset					
Date Format (e.g., dd/mm/yy)					
End date and time of dataset					
Parameter 1	Units	Instrument range			
Parameter 2	Units	Instrument range			
Parameter 3	Units	Instrument range			
Parameter 4	Units	Instrument range			
Parameter 5	Units	Instrument range			
Parameter 6	Units	Instrument range			
Parameter 7	Units	Instrument range			
Parameter 8	Units	Instrument range			
Parameter 9	Units	Instrument range			

Table 8: Excel Data Submission

A	B	C	D	E	F	G
Date	Time	TRS	$PM_{2.5}$	Temp	Wind Speed	Wind Direction
04/01/2006	1:00	-0.031	3.5	0.02	14.4	8
04/01/2006	1:30	-0.026	3.967	-0.148	15.067	4.2
04/01/2006	2:00	0.004	3.8	-0.114	11.467	6.6
04/01/2006	2:30	0.006	3.267	-0.249	10.533	12.9
04/01/2006	3:00	-0.002	6.867	-0.484	9.133	11.3
04/01/2006	3:30	-0.019	1.833	-0.517	5.467	10.4
04/01/2006	4:00	-0.002	5.55	-0.585	3.4	342.8

Table 9: CSV Data Submission

Date,Time,TRS,STEM,TRST
05/29/2007,00:00,1,24,913
05/29/2007,00:30,1,24,913
05/29/2007,01:00,1,23,913
05/29/2007,01:30,No Data,No Data,No Data
05/29/2007,02:00,1,24,913
05/29/2007,02:30,1,23,913
05/29/2007,03:00,1,24,913

Table 10: Sample of Non-Continuous Data Format for Submission

City Street Monitoring Results for TSP and Metals (September 2007)
(results expressed in µg/m^3)

Date	TSP	As	Cd	Cr	Co	Cu	Fe	Pb	Ni	Se	V	Zn	SO_4
September 3, 2007													
September 6, 2007													
September 9, 2007													
September 12, 2007													
September 15, 2007													
September 18, 2007													
September 21, 2007													
September 24, 2007													
September 27, 2007													
September 30, 2007													
Arithmetic mean													
Max. concentration													
Min. concentration													
Standard*													
No. > Sch. 3 value*													
AAQC													
No. > AAQC													
No. of valid samples													
Detection limit													
Half detection limit													
% valid data													

Notes:
All non detectable results were reported as 1/2 the detection limit
* O. Reg.419/05 schedule 3, 24-hour standard

Appendix 4: Sample Edit Log Table

Table 11: Sample Edit Log Table

Emitter's name: Greensmiths Mine and Smelter								
Contact	Name: Will Jones		Phone: (613) 622-7183			Email: Will.Jones@Greensmiths.com		
Station number: 44312			Station Name: Smelter Lane					
Station address: 36 Smelter Lane, Deep River, ON			Emitter address: 1 Park Lane, Deep River ON S4N6R4					
Pollutant or parameter: SO_2			Instrument make & model: Teco 43c				s/n: 6123	
Data edit period	Start date: 01 January 2007		End date: 31 March 2007			EST ☐ CST (Stations in Northwest only)☐		
Edit #	Edit date	Editor's name	Edit Action	Starting		Ending		Reason
				Date (dd/mon/year)	Hour (xx:xx)	Date (dd/mon/year)	Hour (xx:xx)	
1	11-Mar-06	Will Jones	Add Offset 1 ppb	12/Feb/2007	21:00	19/Feb/2007	23:00	Drift
2	11-Mar-06	Will Jones	Delete Hours	03/Feb/2007	18:00	03/Feb/2007	19:00	Equipment malfunction
3	11-Mar-06	Jim Dandy	Delete Hours	19/Feb/2007	21:00	19/Feb/2007	22:00	Span
4								

Examples of Acceptable Edit Actions:
Add offset of
Delete hours
Zero Correction
Slope Correction
Manual data entry for missing, but collected data
Invalidating span & zero check data
Invalidating data due to equipment malfunctions and power failures.
Invalidating data when instrumentation off-line
Marking data as out-of-range

Appendix 5: Wind Speed and Direction Calculations

The following equations used to calculate wind speed and wind direction values were taken from the USEPA document entitled *QA Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Version 1.0 (Draft) EPA- 454/D-06-001, October 2006.* This document is available at:

http://www.epa.gov/ttn/amtic/files/ambient/met/draft-volume-4.pdf

Wind Speed Average Calculation

A. Horizontal wind speed (WSA) is scalar horizontal wind speed

B. Horizontal wind speed (WSA) may be averaged into 1-minute, short term (e.g., 5-minute), and 1 -hour calculations of mean (scalar) horizontal wind speed.

C. The following is the standard form of the equation used for calculating scalar, or horizontal wind speed (WSA):

$$WSA = \frac{\sum_{i=1}^{N} WS_i}{N}$$

where WS_i = instantaneous horizontal wind speed (scalar)
N = number of instantaneous samples (typically 1 second)

Horizontal Wind Direction

A. Horizontal wind direction is a circular function with values limited to between 001 and 360 degrees.

B. The hourly calculation of wind direction mean is a crossover-corrected average of the instantaneous wind direction samples.

C. A crossover algorithm for handling wind direction crossover through north is used that compares the current instantaneous wind direction value to the average of all the preceding wind direction values for the pertinent averaging period. If a difference of more than +180 degrees is found, 360 degrees is subtracted from the current value; or if a difference of less than -180 degrees is found, then 360 degrees is added.

D. The following is the equation used for calculating the mean horizontal wind direction (WDA):

$$WDA = \frac{\sum_{i=1}^{N} WD_i}{N}$$

where WD_i = instantaneous horizontal wind direction (scalar)
N = number of instantaneous samples

Sigma Theta Calculation

A. Sigma theta calculation is the standard deviation of the horizontal wind direction.

B. The standard deviation of the horizontal wind direction, or sigma theta, is calculated from the instantaneous wind direction samples. An algorithm similar to the crossover algorithm used for horizontal wind direction is used for sigma theta.

C. Sigma theta can be calculated and averaged into 1-minute, short term (e.g., 5-minute), and 1-hour means.

D. It has been suggested that the upper limit of sigma theta should be limited to 103.9 degrees (Yamartino, 1984). The equations used do not impose a limit to the range of possible sigma theta values recorded to eliminate any bias that an upper limit may impose.

E. The following is the form of the equation used for computing sigma theta from horizontal wind direction (WD):

$$SigmaTheta = \left[\frac{\sum_{i=1}^{N} (WD_i - WDA)^2}{N-1} \right]^{0.5}$$

where WDA = mean horizontal wind direction
N = number of instantaneous samples

Vertical Wind Speed Calculation

A. Vertical wind speed is the vertical component of wind flow. Vertical wind flow can be positive (upward), or negative (downward).

B. Vertical wind speed (VWSI) can be averaged into 1-minute, short term (e.g., 5-minute), and 1-hour means (VWSA).

C. The following is the form of the equation used for calculating mean vertical wind speed:

$$VWSA = \frac{\sum_{i=1}^{N} VWS_i}{N}$$

where VWS_i = instantaneous vertical wind speed (scalar)
N = number of instantaneous samples

Sigma w Calculation

A. Sigma w is standard deviation of the mean vertical wind speed (VWSA).

B. Sigma w can be averaged into 1-minute, short term (e.g., 5-minute), and 1-hour means.

C. The following is the form of the equation used for calculating sigma w:

$$SigmaW = \left[\frac{\sum_{i=1}^{N} (VWS_i - VWSA)^2}{N-1} \right]^{0.5}$$

where VWSA = mean vertical wind speed (scalar)
N = number of instantaneous samples

Sigma Phi Calculation

A. Sigma phi is calculated using the Sigma w and horizontal wind speed (WSA) data channels.

B. Sigma phi can be averaged into 1-minute, short term (e.g., 5-minute), and 1-hour means.

C. The following is the form of the equation used for calculating sigma phi:

$$SigmaPhi = \frac{SigmaW}{WSA}$$

The above equation yields sigma phi in units of radians and it is converted to degrees using the following equation:

Sigma phi (degrees) = Sigma phi (radians) * 57.2958

Resultant, or Vector Wind Speed and Direction Calculation

A. The hourly calculation of resultant or vector wind speed and direction provide a vector mean of all of the instantaneous samples of wind direction and wind speed sampled each hour.

B. Sigma phi can be averaged into 1-minute, short term (e.g., 5-minute), and 1-hour averages.

C. The following are the equations used for calculating vector wind speed and vector wind direction:

$$U = \frac{\sum_{i=1}^{N} [WS_i \sin(WD_i)]}{N}$$

$$V = \frac{\sum_{i=1}^{N} [WS_i \cos(WD_i)]}{N}$$

$$WDR = \arctan\left(\frac{U}{V}\right) + Flow$$

$$where: Flow = \begin{cases} +180^\circ & \arctan\left(\frac{U}{V}\right) < +180^\circ \\ -180^\circ & \arctan\left(\frac{U}{V}\right) > +180^\circ \end{cases}$$

$$WSR = (U^2 + V^2)^{0.5}$$

where U = east-west component of wind
V = north-south component of wind
WDR = resultant wind direction (vector average)
WSR = resultant wind speed (vector average)

Sigma v Calculation

A. Sigma v is the standard deviation of the instantaneous wind speed normal to the hourly resultant wind direction.

B. Sigma phi can be averaged into 1-minute, short term (e.g., 5-minute), and 1-hour means.

C. The following are the equations used for the calculation of sigma v:

$$SigmaV = \left[\frac{\left(\sum_{i=1}^{N} u_i^2\right)\cos^2 WDR - 2\left(\sum_{i=1}^{N} U_i V_i\right)(\sin WDR)(\cos WDR) + \left(\sum_{i=1}^{N} V_i^2\right)\sin^2 WDR}{N-1} \right]$$

$$where: u_i = WS_i \sin WD_i \qquad and \qquad V_i = WS_i \cos WD_i$$

Glossary of Terms

Audit

A check by ministry staff of the performance of an air quality monitoring system operated by the emitter or their site operator. The field component of the audit consists of assessing compliance/conformance of the sites with established criteria, and in conducting instrument performance checks with certified calibration devices to ensure that the instruments are operating within acceptable tolerances. The other component consists of reviewing documents and procedures to ensure that proper information management practices/procedures have been implemented by the emitter or its site operator, and are followed.

Calibration Check

A test of the accuracy of an instrument using a certified calibration device traceable to a primary standard. If the difference in accuracy between the instrument and the calibration device is greater than ±5%, a calibration of the instrument should be performed.

Calibration

An instrument adjustment with a certified calibration device traceable to a primary standard following an audit or a calibration check when the accuracy of the instrument deviates by more than 5% from the required set point. Instrument calibrations are performed by site operators and not by the auditors.

Certification of calibrators

A test of the accuracy of a calibration device traceable to a primary standard. Certification of calibration devices for gas analyzers will be done annually by the ministry (LaSB) and by a third party for other samplers requiring temperature, pressure and flow calibrations.

Continuous monitoring

Monitoring performed with fully automated instrumentation that collects data on a very short time scale (e.g., every second or minute) such as an ozone or sulphur dioxide analyzer thereby providing real-time data.

Emitter

The person in occupation or having the charge, management or control of a facility that emits air contaminants into the natural environment.

External performance check	QA/QC procedure carried out external to an instrument with a certified calibration unit (e.g., calibrator, gas cylinder, etc., referenced to a primary standard). It is synonymous to a calibration check.
Internal performance check	QA/QC procedure carried out 'within' the analyzer and, as such, consists in all instruments checks not done with a calibrator.
Non-continuous sampling	Sampling conducted with discrete samplers that collect a sample typically over a 24-hour period such as a hi-vol sampler. Samples are collected on a set schedule, such as once every 6^{th} day.
Station operator	The person that performs the regular operation and maintenance of the station. This can be the emitter or a third party retained by the emitter.
Primary standard	The reference standards used by the United States National Institute of Standards and Technology (NIST) against which other standards (secondary) are compared with for accuracy. The certification of calibration devices used must be traceable to a primary standard through secondary standards.
Verification of calibrators	A check of the gas calibration devices used by site operators in the field by ministry audit staff with their calibrators. This is to be done between the annual formal certifications and does not constitute a certification.

Acronyms

AAQC	Ambient Air Quality Criteria as defined and listed in O. Reg. 419/05
ASTM	American Society for Testing and Materials
BAM	Beta Attenuation Monitor, more commonly known as a beta gauge monitor used to measure (in real-time) concentrations of particulate matter, mostly in the PM_{10} and $PM_{2.5}$ size fractions
BIOS	Acronym for ***b**asic **i**nput/**o**utput **s**ystem*, the built-in software that determines what a computer can do without accessing programs from a disk.
CAEL	Canadian Association for Environmental Analytical Laboratories
cm^3/min	Cubic centimeters per minute
cfm	Cubic feet per minute
CFR	Code of Federal Regulations (U.S.)
CST	Central Standard Time
CSV	Comma Separated Values. A data format with values separated by a comma
DAS	Data Acquisition System. The hardware/software of a system used to collect data electronically
Delta Cal	Trade name for a device used to calibrate flow, temperature and ambient pressure
ΔP	Pressure differential
DVM	Digital voltmeter
EMRB	The Environmental Monitoring and Reporting Branch of the ministry
ESA	Portable SO_2 calibrator made by Environnement S.A.
ESDM	Emission Summary and Dispersion Modelling Report. This is one of the key documents required in the application package for an Air Certificate of Approval from the ministry
EST	Eastern Standard Time
FEP	Fluorinated ethylene propylene
GC-MS	Gas chromatography and mass spectrometry
GIS	Geographic Information System
H_2S	Hydrogen sulphide
I.D.	Inside diameter
in. of mercury	Inches of mercury (unit of barometric pressure)
km/hr	Kilometres per hour
L/min	Liters per minute
LaSB	Laboratory Services Branch of the ministry
LCD	Liquid crystal display
m^3	Cubic meter
MDL	Method Detection Limit (analytical lab methods). In this document it is defined as the smallest measurable amount, where the risk of a false positive is 1%, or conversely the confidence level is 99%.
mL/min	Milliliters per minute
MOE	Ministry of the Environment (Ontario)
NIST	United States National Institute of Standards and Technology (NIST)

	which is the source of the primary reference standards for the monitoring/sampling methods listed in this document
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen, principally nitric oxide (NO) and nitrogen dioxide (NO_2)
O.D.	Outside diameter
ng/m^3	nanograms per cubic metre
PAHs	Polycyclic aromatic hydrocarbons
PCDD	Polychlorinated dibenzo-*p*-dioxins, commonly known as dioxins
PCDF	Polychlorinated dibenzofurans, commonly known as furans
PDF	Portable document format
PM	Particulate Matter which is all airborne finely divided solid or liquid material with an aerodynamic diameter smaller than about 100 microns
PM_{10}	Particulate matter with an aerodynamic diameter less than about 10 microns; also known as inhalable particulate matter
$PM_{2.5}$	Particulate matter with an aerodynamic diameter less than about 2.5 microns; also known as fine particulate matter or respirable particulate matter
POI	Point of Impingement as defined in O. Reg. 419/05
ppbv	Concentration of a gaseous contaminant expressed in parts per billion by volume of air sampled
pg/m^3	Concentration of an air contaminant expressed in picograms (10^{-12} gram) per cubic metre of air sampled
PUF	Polyurethane Foam cartridge used for the determination of polycyclic aromatic hydrocarbons (PAHs), dioxins (PCDDs) and furans (PCDFs) in air
QA/QC	Quality Assurance and Quality Control programs to ensure the collection and reporting of data of acceptable quality
RFP	Request for proposal
RTD	Resistance temperature detector
SCC	Standards Council of Canada which accredits analytical laboratories in Canada
SO_2	Sulphur dioxide gas
SOP	Standard Operating Procedure for monitoring/sampling of air contaminants
TEOM	Tapered Oscillating Microbalance. A particulate monitor for determining (in real-time) concentrations of particulate matter, mostly in the PM_{10} and $PM_{2.5}$ size fractions
TEQ	Toxicity Equivalent values are obtained by determining the relative toxicity of a doxin or furan congener to that of 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin) and using these factors for each of the members of a mixture to assign a toxicity to the whole.
TFE	Tetrafluoroethylene
TriCal	Trade name for a device used to calibrate flow, temperature and ambient pressure

TRS	Total Reduced Sulphur compounds consisting mostly of hydrogen sulphide (H_2S) and mercaptans
TSP	Total Suspended Particulate matter, which is all airborne finely divided solid or liquid material with an aerodynamic diameter smaller than about 44 microns. It includes very coarse (diameter >10 microns), PM_{10} and $PM_{2.5}$ particles
USEPA	United States Environmental Protection Agency
URT	Upper Risk Thresholds for air contaminants as listed in schedule 6 of O. Reg. 419/05
UV	Ultraviolet light
µg/m^3	Microgram (10^{-6} gram) per cubic metre of air sampled
µm	Micron which is 10^{-6} of a meter
VOCs	Volatile Organic Compounds some of which play an important role in the formation of ozone and smog aerosols
WINS	Well Impactor Ninety Six, an impactor designed to provide a particle cut-point of 2.5 microns
WMO	World Meteorological Organization

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